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By

Edward H. Robb

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ABSTRACT

A QUARTERLY ECONOMETRIC MODEL OF MICHIGAN

By

Edward H. Robb

The quarterly econometric model of Michigan presented in this paper provides a mechanism for estimating and forecasting personal income by major categories. The model gives special attention to the durable and nondurable goods manufacturing industries, particularly motor vehicles and equipment. It also provides an analytical description of the Michigan economy and, in particular, the interplay between broad aggregate sectors.

Although the model contains 21 stochastic equations, only the parameters of those of the personal income subset were estimated. The equations for consumption and investment were not estimated due to the lack of data. The equations which were estimated represent 11 wage and salary components of personal income and 6 nonwage and salary categories. In addition, the model includes employment in motor vehicles and equipment among the endogenous variables.

The model contained in the paper was the first state model to employ a systems method of estimation. The esti-

mation technique was three-stage least squares. However, due to the presence of autocorrelation in several equations, the normal three-stage technique had to be modified to account for the lack of independence. Given the assumptions of the model, the technique utilized implies both consistant and efficient parameter estimates.

Statistically, the results were quite satisfactory. With the exception of the equation for employment in motor vehicles and equipment the sample data fit the theoretical relationships very well.

As is typically the case, the forecasting results for some equations were better than others. Fortunately, however, the results for those components included in taxable income were quite good with the exception of nonfarm proprietors' income. The forecasts for the wage and salary components were especially encouraging since this portion of personal income comprises the withholding base for the Michigan personal income tax.

The development and the presentation of the model itself was carried out with the explicit aim of making the study useful to policy makers. Some of the results generated by the model indicate its utility for planning and budgeting purposes.

The most common form of forecasting methodology employed in state government is trend analysis, i.e., the normal growth pattern. The problem with this method is that it fails to account for major swings in the economy and the pattern of change throughout the forecasting period. As a test of this point, the forecasting results of the model were compared with the forecast generated by assuming a normal five percent growth. In addition, the forecasting results of a previous econometric model of Michigan were also tested. The model presented in the paper yielded far more accurate forecasts than either of the other models, with only a 1.8 percent error for the six quarter forecasting period.

In terms of Michigan's major revenue sources, the individual income and sales taxes, the 1969 forecast generated by the model had a combined error of only 1.2 percent. Another area where the model may prove useful in its ability to help predict the impact of major strikes in the automobile industry on personal income and the yield of the State's personal income tax. The experience of 1970 provided such an example. The 2 1/2 month strike caused an estimated production loss of over 1.2 million units. In terms of the model this would imply a $205 million reduction in personal income and nearly a $6 million loss in personal income tax revenues.

ACKNOWLEDGMENTS

The construction of the econometric model presented in this paper was made possible only with the assistance of many people. I am indebted to the entire staff of the Research Section of the Bureau of Programs and Budget of the State of Michigan, particularly A. Thomas Clay and Doctor Gerald Miller who reviewed this project and offered valuable suggestions. I am also grateful for the help rendered by Marylyn Donaldson of the Computer Laboratory of Michigan State University with the seemingly endless variety of computer problems I encountered. I am especially indebted for the time and efforts of Doctor Jan Kmenta who served as my thesis director. In addition, the suggestions and comments of Doctor James Ramsey and Doctor Mark Ladenson contributed greatly to the development and presentation of the model. As usual, however, the author claims sole responsibility for all errors and omissions.

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CHAPTER I

INTRODUCTION

Government has, in the last two decardes, undergone a tremendous expansion in both the size and scope of its activities. Accompanying this increased activity has come a concomitant need for increased information, both qualitative and quantitative, to enable the legislative and executive branches of government to fulfill their functions more effectively. While this need has not gone unnoticed at the federal level which each year witnesses more sophisticated methods of analysis being developed to close the "information gap," the same cannot be said for most state and local governmental organizations.[1] This lag in the development and adoption of the newer and more powerful socio-economic tools on the state and local level is made more disturbing since the growth of state and local government activity has been even more pronounced than that at the federal level. Over the period from 1950 to 1968 total federal government receipts

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[1]While it is indeed true that the federal government has been responsible for the development of the vast majority of new techniques and data, it too has been slow in the implementation of these improvements. The result is that a mass of sophisticated (and presumably helpful) analyses and techniques has been filed away far from the individuals actually making the decisions.

and expenditures grew 254 per cent and 345 per cent respectively (non-defense expenditures 279 per cent). Total state and local government receipts and expenditures, meanwhile, grew at respective rates of 402 per cent and 382 per cent.

The lack of both reliable data and comprehensive analysis in state and local government has been acutely prevalent from the viewpoint of economic theory and econometrics, two tools which have received only the most meager attention from state and local governments. While their under-utilizations (and in a few cases, misuse) represents a disquieting oversight from an efficiency oriented position, in that the predictive powers of these tools have gone needlessly untapped, it is even more disturbing given the institutional constraints faced by state and local governments.

Unlike the federal government which controls the money supply, not to mention being able to incur both short and long-run deficits, state and local governments are not only denied the use of the presses but are typically prohibited by their constitutions and/or legislative bodies from operating at a deficit. Given their more restrictive constraints, it would seem that state and local governments would have even a greater incentive to avail themselves of the growing body of econometric techniques. The adoption of these tools would not only enable states to forecast their revenues more accurately, but could also make more efficient the allocation of their revenues between competing alternatives.

The State of Michigan has been no exception to the general rule of inadequate fiscal planning. As Table 1 so palpably shows, Michigan has displayed the common pattern of boom or bust. During the period 1950 through 1968, General Fund-General Purpose expenditures have more than quintupled, rising from a level of $200 million in fiscal 1950 to $1,153 million in fiscal 1968 an increase of 476.5 per cent or at an average annual rate of 9.1 per cent (6.5 per cent from 1950 to 1964). The increase, however, has been characterized by a very erratic pattern. Deficit years have resulted in several "fiscal crises" and the subsequent enactment of austerity budgets, while surpluses have usually given rise to pronounced expenditure increases. In contrast to the average annual increase in expenditures of $35 million, the period 1952-1954 saw no increases in expenditures while periods such as 1954 to 1958, 1960 to 1962, and 1965, 1966, and 1967 have seen expenditures increasing at the rate of over ten per cent per year.[2] (See Table 1)

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[2]The respective increases in fiscal years 1965, 1966, and 1967 were at the extremely rapid rates of 22, 24 and 32 per cent.

Table 1.--State of Michigan, General Fund, general purpose revenue and expenditures, 1950 to 1968. (Millions of dollars)

Fiscal Year Ending June 30	Expenditures	Revenue	Annual Surplus (+) or Deficit (-)	Accumulated Surplus (+) or Deficit (-) (End of Year)
1950	200.4	156.8	- 43.6	- 21.4
1951	206.0	179.7	- 26.3	- 40.9
1952	223.7	194.1	- 29.6	- 65.3
1953	225.3	240.8	+ 15.5	- 31.3
1954	223.1	261.1	+ 38.0	+ 5.8
1955	252.8	264.6	+ 11.8	+ 17.0
1956	277.7	286.3	+ 8.6	+ 25.6
1957	330.9	312.1	- 18.8	+ 6.7
1958	367.0	328.7	- 38.3	- 21.2
1959	376.3	298.8	- 77.5	- 95.5
1960	386.2	418.1	+ 31.9	- 64.0
1961	429.9	430.6	+ 0.7	- 71.7
1962	476.4	458.8	- 17.6	- 85.6
1963	492.3	564.0	+ 71.7	- 22.8
1964	523.5	596.0	+ 72.5	+ 57.1
1965	650.2	746.3	+ 96.1	+153.2
1966	793.9	841.9	+ 48.0	+201.2
1967	1,049.2	893.3	-155.9	+ 45.3
1968	1,152.5	1,186.8	+ 34.3	+ 79.6

Source: 1950-1964 figures are taken from Harvey E. Brazer, "Michigan's Fiscal Outlook," Wayne Law Review, Vol. 2, No. 2 (1967), pp. 430-50. 1965-1968 figures by State of Michigan, Executive Office, Bureau of the Budget, Budget Division.

This highly unstable pattern of expenditures not only imposes intense pressures upon state personnel and programs, but also makes efficient planning and programing nearly impossible. A further consequence is the difficulty it causes in attempting to maintain a level and quality of government services commensurate with the capacity of the State's economy and the demands of its citizens. With Michigan's population growing at approximately 1.2 per cent per year and with prices paid by the State (including wages and salaries of State employees) rising at over three per cent, the per capita supply of government services of constant quality must necessarily be curtailed or the quality reduced anytime the year-to-year increase in appropriations falls below 4 to 4.5 per cent.

The reasons for this pattern of fiscal instability have been varied. As with any government institution, politics is inextricably tied to both the level and allocation of expenditures. Nevertheless, the primary constraint in determining the level of expenditures has to be the level of its revenues. Given certain institutional constraints (including the state's tax structure), the level of expenditures is basically determined by the forecasted level of its revenues. Given the state's desired minimal level of services, however arrived at, if the forecasted level of revenues is at least sufficient to meet the expenditure level implied by the desired level of services, no further action is immediately required. If the forecasted level of revenues falls short of the necessary level of expenditures, further action, e.g., a rise in tax rates, etc., is indicated. However, a problem many states have experienced in the past, including Michigan,[3] is that of accurately forecasting the level of the state's revenues.[4] The techniques employed for this purpose range from the crystal ball at one extreme to econometric analysis on the other. Unfortunately, most state and local forecasting has not been at the "other" extreme or even close to it, with the "normal" pattern, i.e., time trend analyses, probably being the most prevalent forecasting method. The problem with using this type of analysis is that in a very real sense it is merely a facade covering

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[3]Michigan has done extremely well in forecasting total revenue in the last several years as Table 2 indicates.

[4]The problem of forecasting tax revenues, much the same as forecasting anything else in a world of imperfect knowledge, is a difficult one. Forecasting tax revenues, however, interjects an added phenomenon. Due to the persistent tendency on the part of the individuals doing the forecasting to be conservative, a tendency which seems to be accentuated the less sophisticated the methodology and, hence, the less confident they are with their forecast, most revenue estimates understate the actual yields. Building in a strong downward bias to be on the "safe side" is bad enough, especially from an academic viewpoint, but such a phenomenon, if at all recurrent, seldom goes unnoticed by state legislators for very long, and as a result of compensating for the bias, they in essence do the final forecasting.

Table 2.--State of Michigan, record of revenue estimates, General Fund budget (in thousands).

For Fiscal Year	Long-Range Estimate (18 Mos. or More Ahead)		Short-Range Estimate (6 Mos. or More Ahead)	
	General Purpose (1)	Total Fund (2)	General Purpose (3)	Total Fund (4)
1949-1950	$ 228,949	$ 384,621	$ 223,491	$ 400,388
150-1951	229,895	400,893	259,505	449,366
1951-1952	265,766	462,191	293,774	505,991
1952-1953	301,888	529,615	304,222	525,240
1953-1954	306,557	532,396	371,081	586,167
1954-1955	365,541	574,826	373,206	588,500
1955-1956	246,171	415,995	287,955	474,662
1956-1957	315,003	505,046	316,364	518,441
1957-1958	335,782	541,286	316,015	524,086
1958-1959	333,542	545,769	290,466	514,551
1959-1960	307,858	539,134	415,882	650,231
1960-1961	409,328	644,852	443,117	686,830
1961-1962	477,921	734,929	452,384	711,082
1962-1963	468,350	733,256	546,353	819,979
1963-1964	560,591	839,164	593,957	887,024
1964-1965	674,570	910,401	727,459	991,570
1965-1966	756,145	1,034,210	816,436	1,174,562
1966-1967	878,036	1,268,155	896,355	1,299,429
1967-1968	932,909	1,358,833	1,159,644	1,619,068
1968-1969	1,337,065	1,864,288		

Table 2.--Continued)

Actual Revenue		Percentage Variation (Actual Over or (Under) Estimate)			
General Purpose (5)	Total Fund (6)	Col. 5 vs 1	Col. 6 vs 2	Col. 5 vs 3	Col. 6 vs 4
$ 232,475	$ 402,492	1.5	4.6	- .4	.5
260,550	460,140	13.3	14.8	.4	2.4
285,172	493,617	7.3	6.8	- 2.9	- 2.4
349,684	577,669	15.8	9.1	14.9	10.0
369,445	581,411	20.5	9.2	- .4	- .8
383,213	605,726	4.8	5.4	2.7	2.9
286,332	473,678	16.3	13.9	- .6	- .2
312,063	502,505	- .9	- .3	- 1.4	- 3.1
328,661	535,639	- 2.1	- 1.0	4.0	2.2
298,784	522,668	-10.4	- 4.2	2.9	1.6
418,103	654,746	35.8	21.4	.5	.7
430,573	676,019	5.2	4.8	- 2.8	- 1.6
458,750	720,469	- 4.0	- 2.0	1.4	1.3
563,993	842,806	20.4	14.9	3.2	2.8
614,008	909,137	9.5	8.3	3.4	2.5
746,337	1,004,283	10.6	10.3	2.6	1.3
841,873	1,171,375	11.3	13.3	3.1	- .3
893,228	1,281,249	1.7	1.0	- .3	- 1.4
1,171,811	1,644,964	a	a	1.0	1.6

[a]New tax base.

Source: State of Michigan, Executive Office, Bureau of Programs and Budget.

up one's ignorance of the true causes of a given phenomenon. On a pragmatic level its use also has the disadvantage of not enabling one to forecast severe deviations from the trend, which is the major contributing factor to bad revenue forecasts.

However, from a broader perspective the seemingly dominant role of accurate revenue estimation in overall fiscal planning is often mitigated. This is due to the separate, though related, problem of the correct time horizon. Most state legislators, and more importantly members of the executive branch, have exhibited a very short time horizon with regard to both revenues and expenditures, the most common horizon being one year. The problem with a one year horizon is that it is not long enough to insure that the level of governmental services will be sufficient to meet the present and future demands of the population. What is needed is not only more accurate revenue forecasts, but in addition revenue (and expenditure) projections for more than the ensuing fiscal year.

The under-utilization of economic tools on the part of state and local governments may be waning, at least as far as Michigan is concerned. In the last few years Michigan has begun to exhibit some signs of closing the information gap. Most notable was the state's purchase of an

Econometric Model of Michigan (more commonly known as the Suit's Model) in 1966 and more recently the implementation of cost-benefit analysis to aid in a better allocation of state revenues. Although these actions have been encouraging, there is still a need for better econometric models, particularly in light of the fiscal reform package enacted in 1967 which added two new major revenue sources to the state's tax system--a personal and corporate income tax.

In that good forecasts rest ultimately on a good understanding of the process to be forecasted, it is to be hoped that the quarterly econometric model presented here will provide a more accurate description of the economic framework of Michigan and aid in improving forecasts of the all important revenue base.

Chapter II of this dissertation reviews previous state econometric models. Chapter III presents a quarterly econometric model of Michigan. The model provides a basis for estimating current levels of personal income by major components. Due to the special nature of the Michigan economy, special attention is given to the durable goods manufacturing industries, particularly motor vehicles and equipment. Chapter IV contains an evaluation of the results and some concluding remarks.

CHAPTER II

ANALYSIS OF PREVIOUS STATE ECONOMETRIC MODELS

In contrast to the situation at the national level, there has been little work done in the area of state and regional econometric models. Underscoring this is the fact that to date only four state income models have been constructed.[1] The first of these was A Quarterly Economic Model for the State of California developed by Richard P. Burton and John W. Dyckman in 1965. The second effort, An Econometric Model of Michigan, was prepared by the University of Michigan's Research Seminar in Quantitative Economics under the direction of Daniel B. Suits in 1966. The third model, An Econometric Forecasting Model for a Region, was constructed for the State of Massachusetts by Frederick W. Bell in 1967. The most recent endeavor is An Econometric Model of Ohio developed by W. L. L'Esperence, G. Nestel, and D. Fromm in 1968. All four models have as the primary

[1]This enumeration does not include a number of state and regional growth models, e.g., the model of the Upper Midwest constructed by J. Henderson and A. Krueger and the growth model of Georgia constructed by H. Thomassen.

goal the estimation and extrapolation of a major indicator of economic activity--either gross state product and/or the equivalent of state personal or disposable income. Appendix A provides a general comparison of the overall characteristics of the four state econometric models. In addition, the models of Michigan, Ohio, and Massachusetts are reproduced in their entirety.[2] (See Appendix A.) However, because of its size (over 100 equations) the California model is not presented except for a general analysis of its methodological approach.

California Model

The first major effort at constructing a state econometric model, A Quarterly Economic Model for the State of California, was surprisingly the most ambitious of all the attempts. First of all, it was formulated on a quarterly basis, and secondly, it attempted to do more in the sense that it carried disaggregation further than either the Michigan, Massachusetts, or Ohio models. While the latter three models estimate only total personal or disposable income, the California model estimated personal income by major sector, including wages and salaries in 59 Standard Industrial Code (SIC) groupings, and five nonwage

[2] With the exception that the employment subset of the Michigan model is omitted.

and salary income sectors exclusive of personal contributions for social insurance (other labor income, farm and non-farm proprietors' income, property income and transfer payments). A unique feature of the wage and salary subset is that within each of the 59 SIC groupings payrolls are further disaggregated into three exclusive and exhaustive categories--wage and salary disbursements originating from inter-industry, final local, and export demand--where such disaggregation was meaningful.[3] The model also includes an employment subset which covers most of the wage and salary subsectors. In addition, self-assessed taxable sales by nine categories[4] were estimated, as were total corporate net income for financial and non-financial institutions, assessed motor vehicle gasoline gallonage, and total unemployment. In view of the scope of the model, the only analysis which will be set forth will be that which is applicable to the entire model.

In many respects the model is perhaps a little too ambitious given the data constraints which have and do

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[3]In some instances where inter-industry or local-final demand was less than five per cent or where inter-industry demand is generated by many customer industries, local-final and inter-industry demand were combined.

[4]Those categories are building supplies and furniture, general merchandise and specialty items, food, automobiles, gasoline, apparel, business and personal services, restaurants and bars, manufacturing, wholesaling, contracting, and miscellaneous.

plague attempts at constructing regional and state models. In their effort to circumvent the difficulty imposed by the scarcity of data, Burton and Dykeman had to postulate two more or less tenuous assumptions.

I. That wage and salary disbursements in the ith industry are reasonably good "surrogate" for that industry's physical output as measured in value-added terms.

II. That the relative proportions of demand in an industry between inter-industry, local-final, and export demand are constant over time.

The first assumption was necessitated by the intended scope of the model and the lack of corresponding data. The second assumption, likewise, was the result of the limitations of the data (the estimated values of the individual demand proportions rest upon a single annual observation).

The question as to the plausibility of the two assumptions aside, the model does contain a blatant and perhaps damaging fault. The estimation method used was OLS, which under the assumptions of the general "classical" linear regression model exhibits all of the desirable qualities of an estimation technique. The problem regarding the California model is that not all of these assumptions are met--namely, that of the independence between regressor and regressand. For all but a very few exceptions: the general form of the equations is as follows:

$$X_{s_t} = a_0 + a_1 X_{t-1} + \sum_{j=2}^{k} 2_j \Delta Z_{j_{t-1}} + e_t$$

where

X_{s_t} is the wage and salary disbursements in the s subset (1 = local final, 2 = interindustry, 3 = export)

X_{t-1} is the total wage and salary disbursements in the x^{th} industry (the sum of local final, interindustry, export)

$\Delta Z_{j_{t-1}}$ is the first difference of any other independent variable

e_t is the structural disturbance term,

The authors state that this general type of equation was chosen in an attempt to eliminate serial correlation, "In this way the mutual dependence of successive observations, i.e., trend is explicitly taken into account."[5]

The problem with this methodological approach is that the ratio of X_{s_t}/X_t (s = 1,2,3), for all industries and time periods are constants since the estimates for the shares in each of three demand subsectors were generated from a single observation. Hence, the equations could be rewritten as:

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[5]A Quarterly Economic Model for the State of California, p. 40.

$$X_{s_t} = a_0 + a_1^* X_{s_{t-1}} + \sum_{j=2}^{k} a_j \Delta Z_{j_{t-1}} + e_t$$

where

$$a_1^* = a_1/k \qquad \text{and} \qquad k = X_{s_t}/X_t$$

However, since the estimation technique employed was OLS, the necessary independence of regressor and regressand is not maintained and the estimate of the parameters will be biased, although still retaining the desirable asymptotic properties.

If indeed the inclusion of the dependent variable lagged one period among the regressors was for the purpose of eliminating serial correlation, as stated by the authors, the correct procedure would entail altering the estimation technique, replacing the OLS estimates with ones which were more efficient. This approach would also have eliminated including independent variables for which no theoretical justification has been made.

While on the subject of estimation techniques, it would seem that the entire approach of the California model is questionable. Although not explicitly specified as such, the model is a system of simultaneous structural equations. Furthermore, it reduces to a recursive system as the variable participation matrix (VPM) of the equations readily demonstrates.[6] Given the fact that all of the equations are over-identified, at least with respect to the order condition of identification, it would seem that instead of making the possible heroic assumption that the contemporary disturbances between individual equations are not correlated, i.e., $E\,\varepsilon_{it}\,\varepsilon_{jt} = 0$ for all t and $i \neq j$ (this is in addition to the usual assumption of a lack of any serial correlation $E\,\varepsilon_{it}\,\varepsilon_{j(t-s)} = 0$ for all i and j and $s \neq 0$) it would be better to make only the usual assumption as to the lack of any serial correlation and then employ either three-stage least squares (3SLS) or full information maximum likelihood (FIMLE) estimation methods.[7]

Michigan Model

The model of Michigan present here (or the Suit's Model as it is commonly known) was taken intact from An Econometric Model of Michigan, Technical Report No. 3, published by the State Resource Planning Division, Michigan Department of Commerce. In its final published form the presentation of the model leaves much to be desired from anything but a very elementary vantage point since the

[6]This analysis does not apply to the employment subset. The dimension of the VPM of the rest of the system is 123 x 123 and therefore is not presented.

[7]If there is serial correlation, it can be taken into account by making allowance for it in either of the two estimation procedures.

statistics relating to the coefficients and the equations were omitted and were not available from other sources. In an attempt to rectify this inadequacy it was necessary to re-run the data published in the Report to generate the missing statistics. The parameters were estimated using OLS, the estimation technique employed by Suits.

The most salient characteristic of the refitted equations are the remarkably small values of some of the coefficients of determination corrected for degrees of freedom ($\bar{R}^2$). While the major equations, especially those for gross state product (GSP) and gross state product originating in manufacturing (GSPMFG), exhibit very good fits, only five other equations have a $\bar{R}^2$ statistic greater than .800, and ten have a $\bar{R}^2$ statistic less than one-half (the equation for Michigan retail sales by food stores has a startlingly low value of only 0.094). From these values it would seem that utilizing the complete model for forecasting purposes would be at a minimum a risky undertaking.

Another characteristic, almost as disquieting, is the fact that many of the coefficients (13 not including the constants) are not significant at over the 90 per cent confidence level. The most notable are the equations for Michigan Retail Sales of Building, Lumber and Hardware Michigan Retail Sales of Food Stores where not only is the constant insignificant at the 90 per cent level (which is quite common) but neither is the only other independent variable, United States Automotive Expenditures.

In addition, there is at least one instance of positive serial correlation, namely in the equation for retail sales by furniture stores (Michigan Retail Sales by Furniture Store). The critical levels (lower bounds) of the Durbin-Watson statistic being respectively 0.59 and 0.82 at the 0.01 and 0.05 confidence levels. In addition, twelve other equations have a Durbin-Watson statistic which falls between the upper and lower boundaries, and hence inferences as to serial correlation are not possible.[8]

Massachusetts Model

The econometric forecasting model of Massachusetts written by Frederic Bell is the most mathematical of the four state models and exhibits the strongest ties with micro-economic theory. It splits the total state received income into two components--export income and local service income, thus explicitly delineating the effect of non-regional forces on the state's economy. Other than the three income determination equations, the rest of the model deals with the state's production, investment, population,

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[8]The other widely used test for serial correlation, the Von Neumann ratio test of Theil and Nagar is not applicable in this instance since the equations were estimated in first difference and hence do not meet the requirement that the first and higher order differences of the explanatory variable are small compared with the range of the corresponding variables themselves. For a complete exposition on this point see Theil and Nagar, "Testing the Independence of Regression Disturbances," American Statistical Association Journal, Mar-Apr., 1961, pp. 793-806.

labor supply and labor demand functions. Hence, in a sense, it represents a miniaturization of the national GNP models.

As the variable participation matrix (Figure 1) readily demonstrates, the system is an integrated one. All the equations are over-identified using the order criterion. The primary estimation technique was 2SLS. However, since some of the equations are functions of only predetermined variables, the OLS estimates of their parameters are also 2SLS estimates since no endogenous variables appear on the right hand of these equations. The capital stock equation was estimated using reduced-form least squares (RFLS).

The production function was also estimated using OLS. However, the elasticities of factor inputs were estimated by using the geometric means of factor shares which were taken as unbiased estimates of these parameters. The constant is the 1947 base value. Hence, the only OLS estimate is that of the rate of technological change--which is the output residual (i.e., output unexplained by factor increases).

Ohio Model

The most recent state model, An Econometric Model of Ohio, represents a vast improvement over the pioneering efforts of the models for Michigan and California. The model is truly an econometric one, qualifying to be called

Mass. VPM		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1.	I_m	*								*								
2.	I_{nm}		*								*							
3.	U			*				*					*					
4.	S				*	*												
5.	V_1				*	*										*		
6.	V_2						*	*	*									
7.	L							*	*									*
8.	K								*	*	*							
9.	K_m									*						*		
10.	K_{nm}				*						*							
11.	N_e											*			*			
12.	N_o												*		*		*	
13.	P_o													*				
14.	P_e														*			
15.	X															*		
16.	M																*	
17.	W																	*

Figure 1.--Variable participation matrix of the Massachusetts Model.

such by even the most ardent theoretic behaviorists. Its micro and macro-economic underpinnings are solid, as witnessed by the investment and personal income equations.

From the point of being a truly useful analytical tool and aid for state policy decisions, it is the best of the four models. In addition, it has among its predetermined variables several policy variables of the U.S. Federal Government (as does the California model) which allows some analysis of the impact of changes in these instruments on the Ohio economy.

From a critical viewpoint, little can be said to detract from the model other than the qualifications imposed by the paucity of data and those enumerated by the authors themselves. However, as with all the other models, the estimation technique employed is open to a modicum of criticism.[9]

As indicated in Appendix A, the Ohio Model contains 27 equations. Eleven of these are identities. The remaining 16 equations are identified, at least according to the order condition (a necessary but not a sufficient condition). The parameters in eight of the equations were estimated using both 2SLS and OLS. The parameters of the

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[9] The asymptotic properties of an estimator may be of little comfort, however, in the case of the Ohio and Massachusetts Model where the number of observations is small and where the relative small sample properties of the estimators may be more relevant.

other eight were estimated solely by OLS since their 2SLS estimates are identical with those obtained by OLS. The causal ordering of the model is reproduced in Figure 2.

> The arrows indicate the causal ordering among the endogenous variables. The interdependence in the model is due to the interaction among the consumer sector, income flows and gross state products in services, finance, insurance, real estate and trade. For example in Figure 1, sales by new car dealers (A) affects the annual change in automobile registration (ΔAR) and gross state product in trade (GSP_{td}) which in turn affects disposable personal income (DPI) which is an explanatory variable of sales by new car dealers (A). The interdependence is contained in Block II (Figure 1). Blocks I and III are recursive.[10]

It would seem, given this approach, that the authors are implying that the model is non-integrated, i.e., the three blocks are independent. If this is the case, matrix of coefficients of the predetermined variables (B) is block diagonal and the variance-covariance matrix is also block diagonal having the same size blocks as does B, then the separate estimation techniques applied to the three delineated blocks would have yielded consistent estimates of the respective parameters within the equations of those blocks. However, as the Ohio VPM demonstrates (Figure 3) such is not the case. Instead of being block diagonal, the B matrix is integrated.

In summary, the previous state models have suffered from one of several shortcomings. The least damaging is

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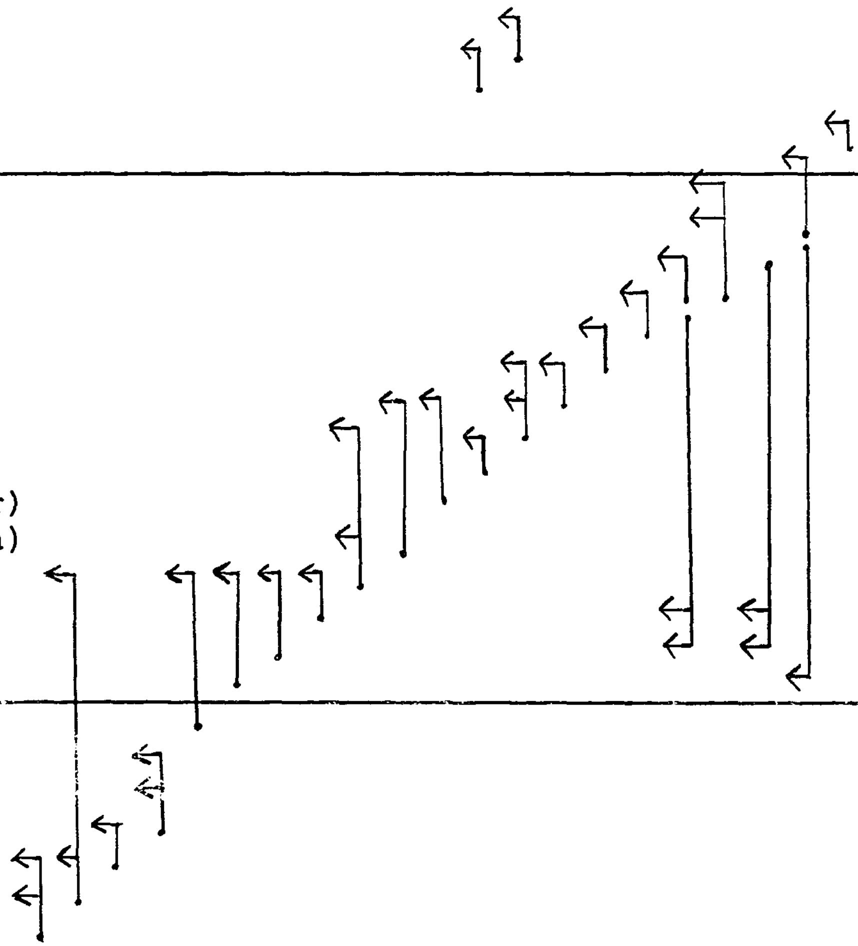
[10] An Econometric Model of Ohio, p. 14.

	Causal Ordering of the Ohio Model	Exogenous Variables
Block I	1. F_T	
	2. AR	AR_{-1}
	3. ΔAR	AR_{-1}
	4. T_s	
	5. C	
Block II	6. A	(ΔAC)/AC, AR_{-1}
	7. R	
	8. ΔDPI	DPI_{-1}
	9. DPI	
	10. FIT	
	11. PI	
	12. ΔGSP	
	13. GSP	GSP_{-1}
	14. GSP (other)	GSP $(other)_{-1}$
	15. ΔGSP (other)	GSP $(known)_{-1}$
	16. ΔGSP (known)	
	17. GSP (known)	GSP_{fg}, GSP_{slg}
	18. GSP_{fi}	
	19. GSP_{so}	
	20. GSP_{td}	
Block III	21. GSP_{cc}	HP
	22. Ima	
	23. Isam	RCB
	24. Imma	IGF_{ma-1}, $Isma_{-1}$; RTS
	25. IGF_{m2}	
	26. GSP_{ma}	GSP_{ma-1}
	27. ΔGSP_{ma}	ΔGNF_{ma}; MPC



Source: An Econometric Model of Ohio, p. 15.

Figure 2.--The causal ordering of the Ohio Model.

	Ohio VPM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Block I	1. F_t	*	*																									
	2. AR		*	*																								
	3. ΔAR			*			*																					
	4. T_s				*	*																						
	5. C					*	*	*																				
Block II	6. A						*			*																		
	7. R							*		*																		
	8. ΔDPI								*	*																		
	9. DPI									*	*	*																
	10. FIT										*	*																
	11. PI											*	*	*														
	12. GSP (other)												*	*					*									
	13. GSP													*	*													
	14. ΔGSP													*	*	*												
	15. ΔGSP (other)															*	*											
	16. ΔGSP (known)																*	*										
	17. GSP (known)																	*	*	*	*	*						
	18. GSP_{fi}								*	*									*									
	19. GSP_{so}								*	*										*								
	20. GSP_{td}						*	*													*							
Block III	21. GSP_{cc}																					*		*				
	22. I_{ma}																						*	*	*			
	23. I_{sma}																							*	*			
	24. I_{mma}																								*	*		
	25. IGF_{ma}																									*	*	*
	26. GSP_{ma}																										*	*
	27. ΔGSP_{ma}																											*

Figure 3.--Variable participation matrix of the Ohio Model.

the annual format employed in the Massachusetts, Michigan, and Ohio Model. The problem with the annual format is a pragmatic one in that it does not allow one to readily update the model, nor observe shorter run economic fluctuations which may have serious revenue implication. The remaining criticisms have to do with the estimation technique employed. In the case of the California Model the method of estimation (OLS) does not yield consistent estimates of the parameters. And more generally, all of the models fail to utilize the more efficient estimation techniques available. In order to eliminate these faults the model of Michigan set out in the following chapter employs a quarterly format and utilizes 3SLS which given the assumptions of the model implies both consistent and efficient parameter estimates.

CHAPTER III

A QUARTERLY ECONOMETRIC MODEL OF MICHIGAN

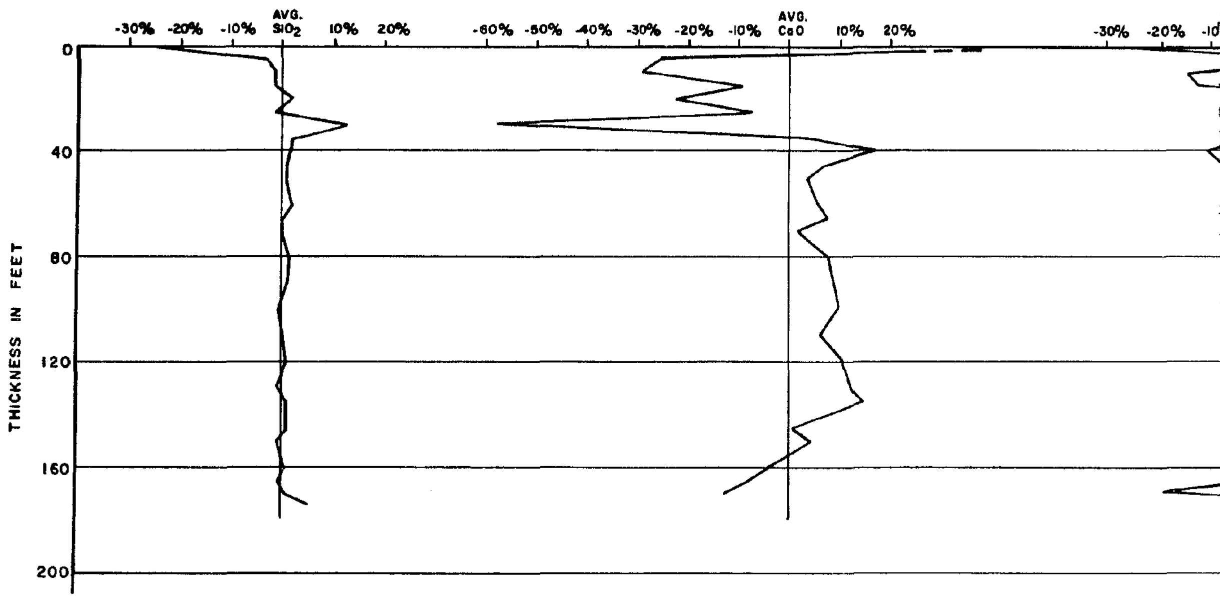
In contrast to most national, regional, or state econometric models, the model presented in this paper deals solely with personal income. Its primary purpose is to provide a vehicle for forecasting Michigan personal income.

While the model presented here does not contain either a disposable income or tax subset, it does provide a starting point for the development of such sectors. Since the intended goal of this model was to aid in improving the accuracy and current estimates of Michigan's tax revenues, in particular the income and consumption taxes, the construction of a quarterly model of personal income appeared to be the most germane and fruitful first step.

The general model envisioned for Michigan may be set out as follows:

$$PI = WS + NWS \tag{3.1}$$

$$WS = \sum_{i=1}^{16} WS^i \tag{3.2}$$



THICKNESS IN FEET
0
40
80
120
160
200
-30% -20% -10% AVG. SiO_2 10% 20%
-60% -50% -40% -30% -20% -10% AVG. CaO 10% 20%
-30% -20%

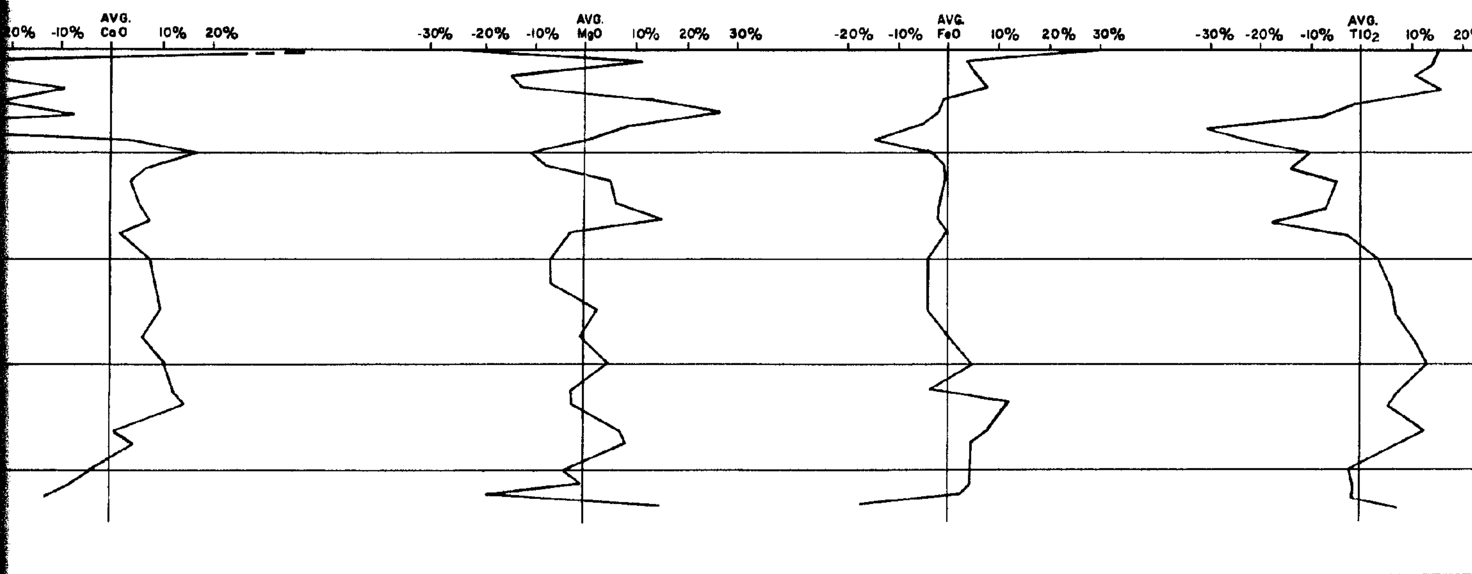


FIGURE 5
CHEMICAL COMPOSITION OF SCALES CR
DIAMOND DRILL HOLE D 64

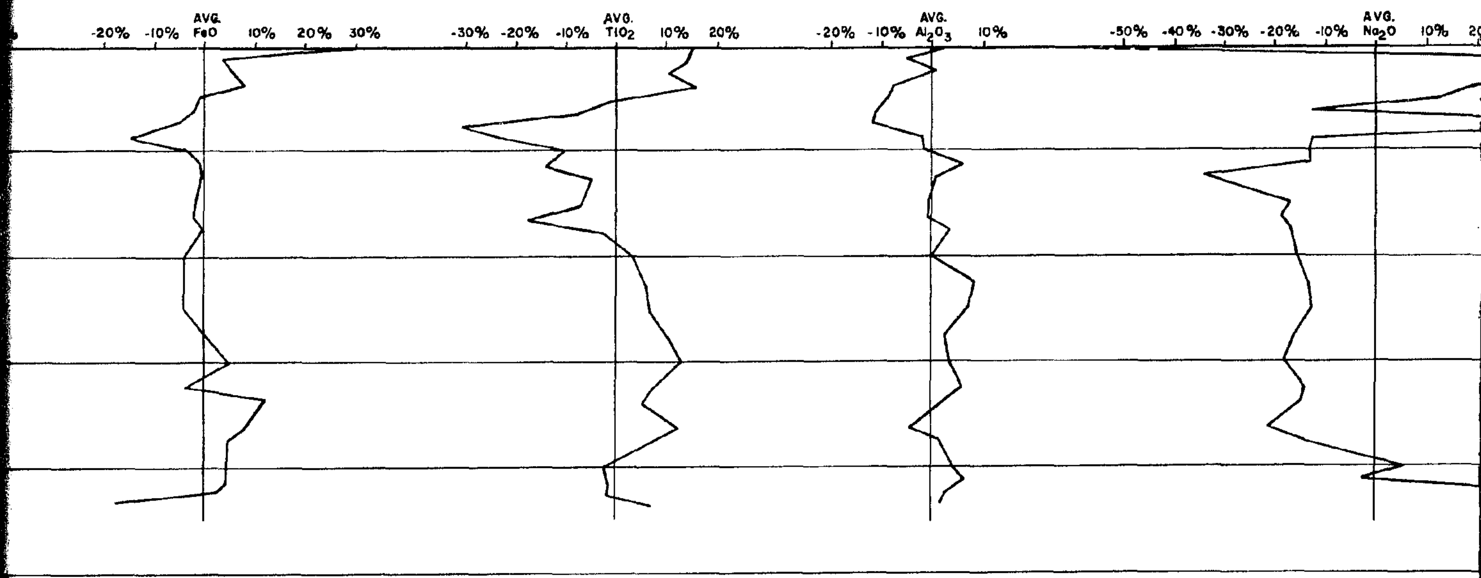
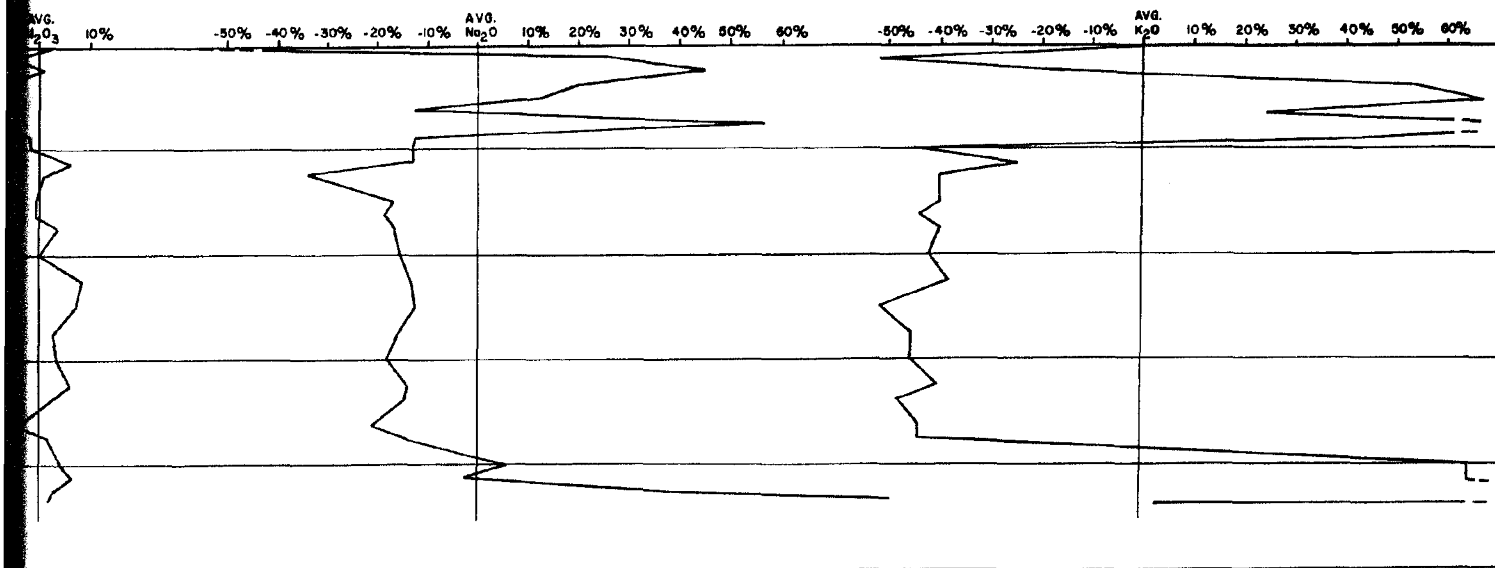
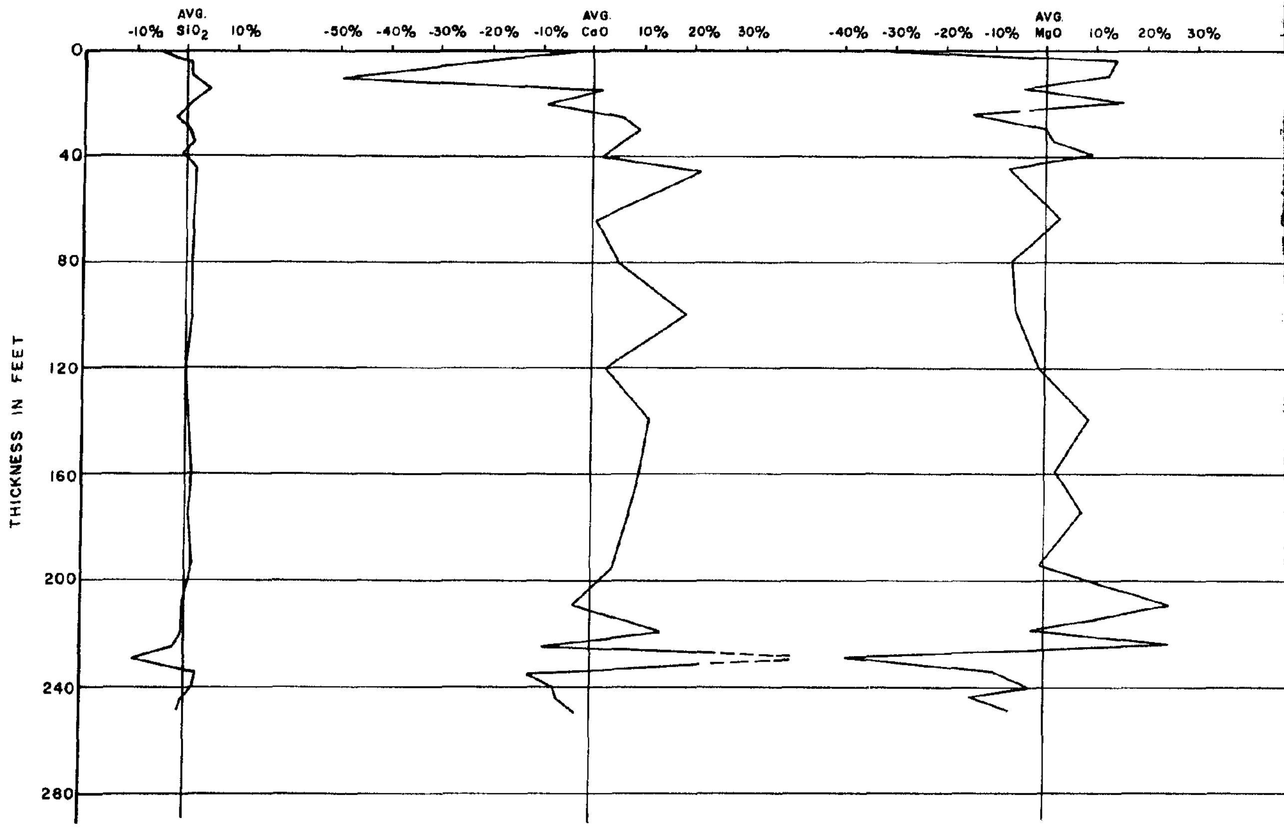


FIGURE 5
CHEMICAL COMPOSITION OF SCALES CREEK FLOW
DIAMOND DRILL HOLE D 64


AVG. Al_2O_3
10%
-50%
-40%
-30%
-20%
-10%
AVG. Na_2O
10%
20%
30%
40%
50%
60%
-50%
-40%
-30%
-20%
-10%
AVG. K_2O
10%
20%
30%
40%
50%
60%


AVG.
-10% SiO_2 10%
AVG.
-50% -40% -30% -20% -10% CaO 10% 20% 30%
AVG.
-40% -30% -20% -10% MgO 10% 20% 30%
THICKNESS IN FEET
0
40
80
120
160
200
240
280

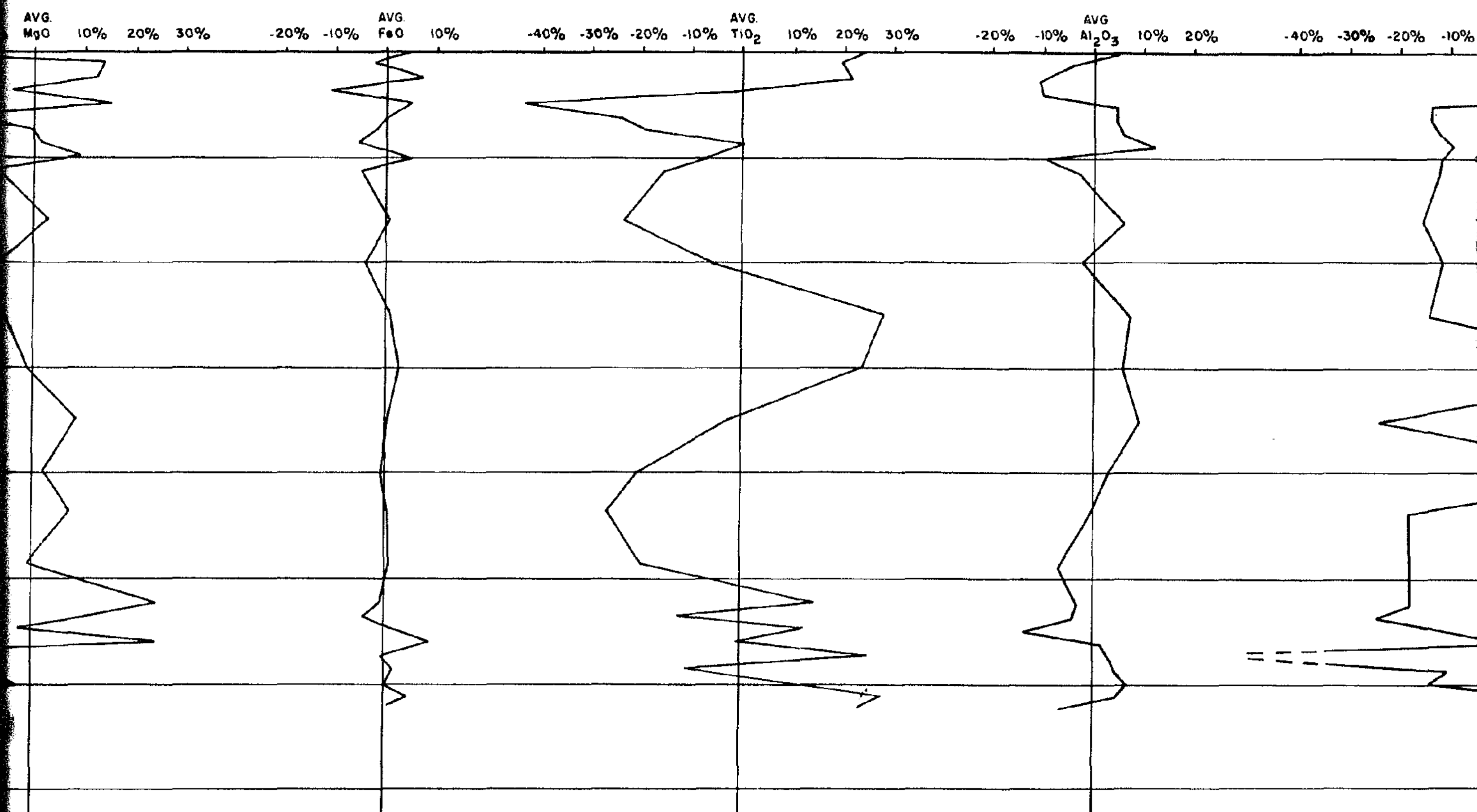
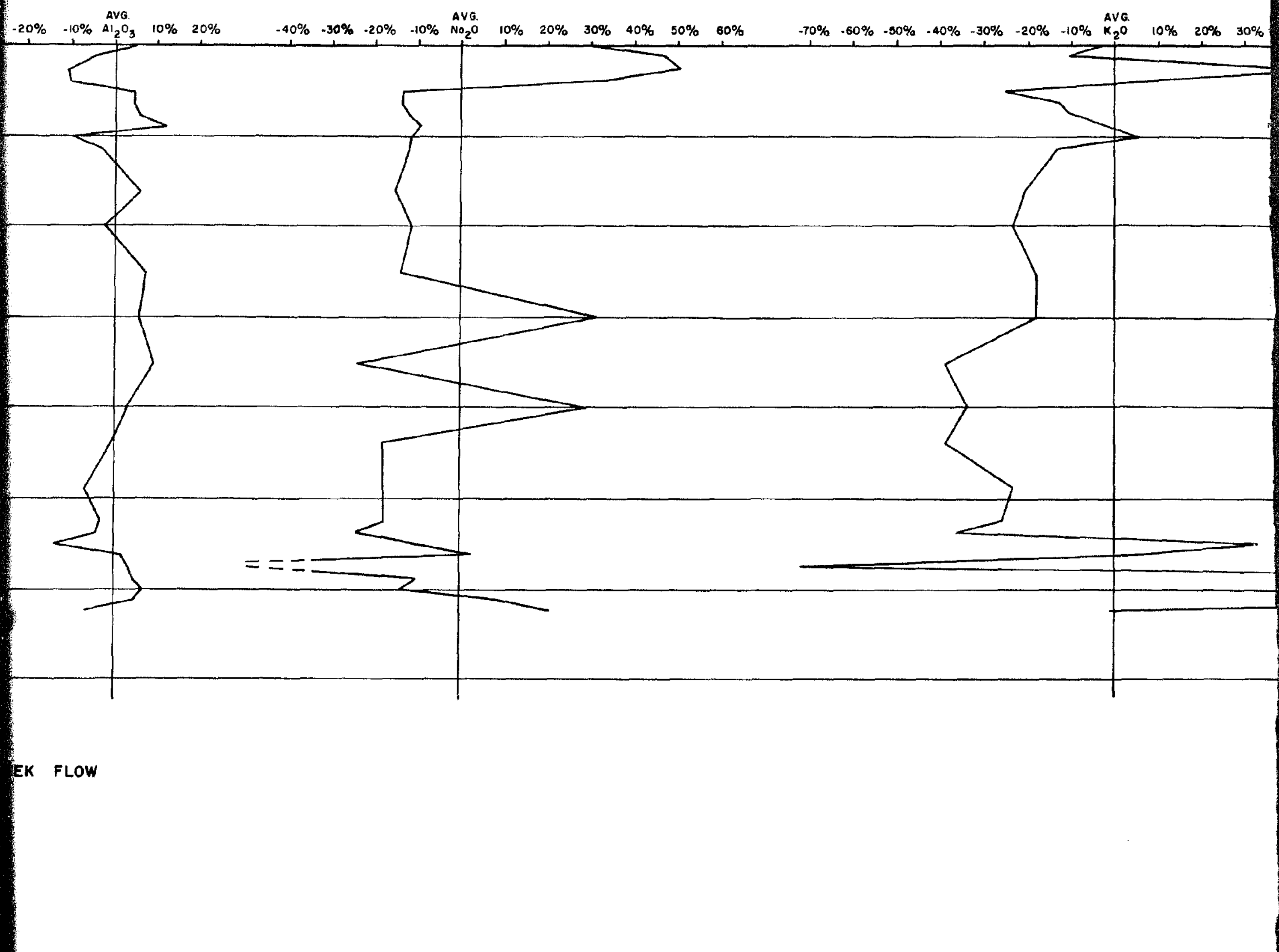
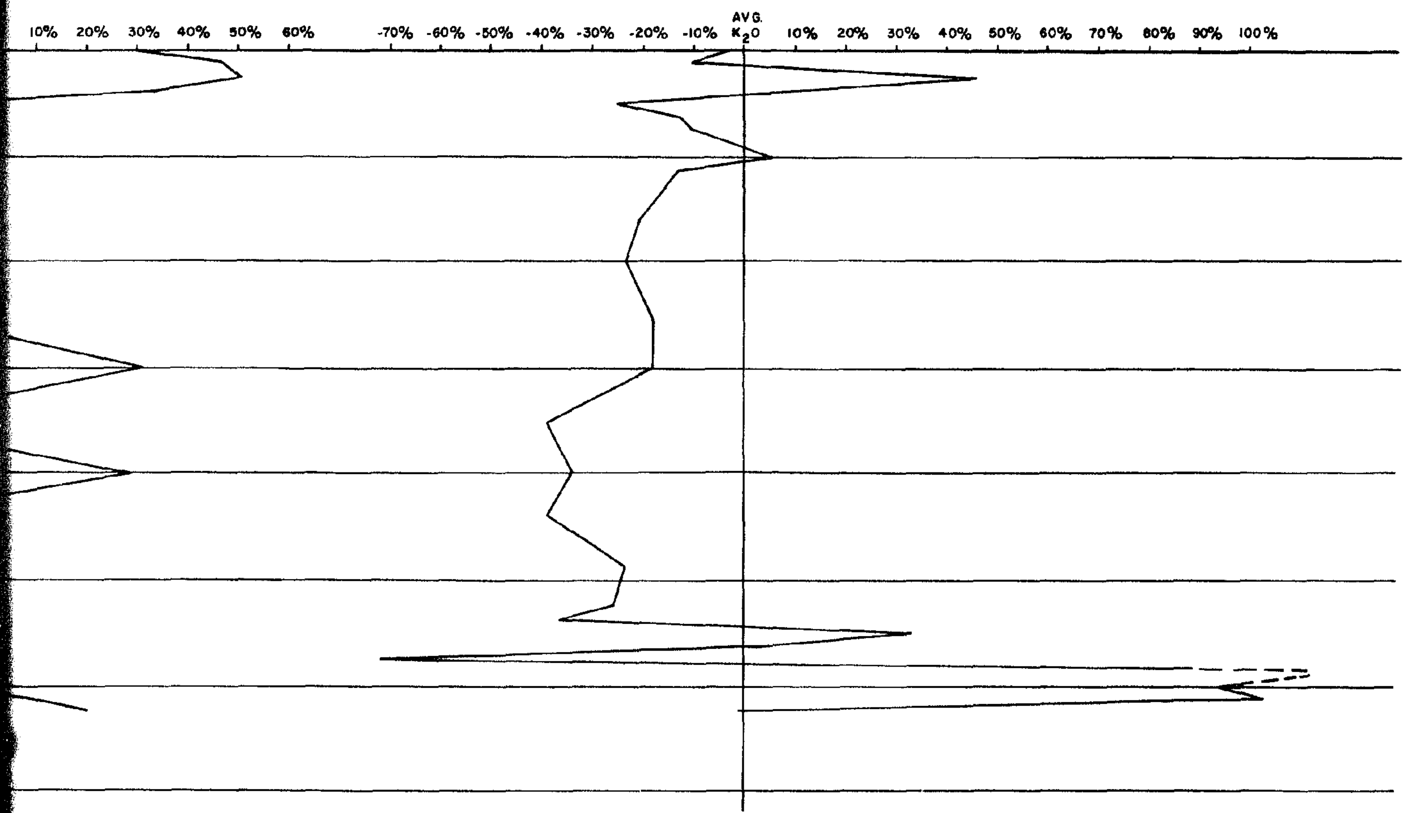
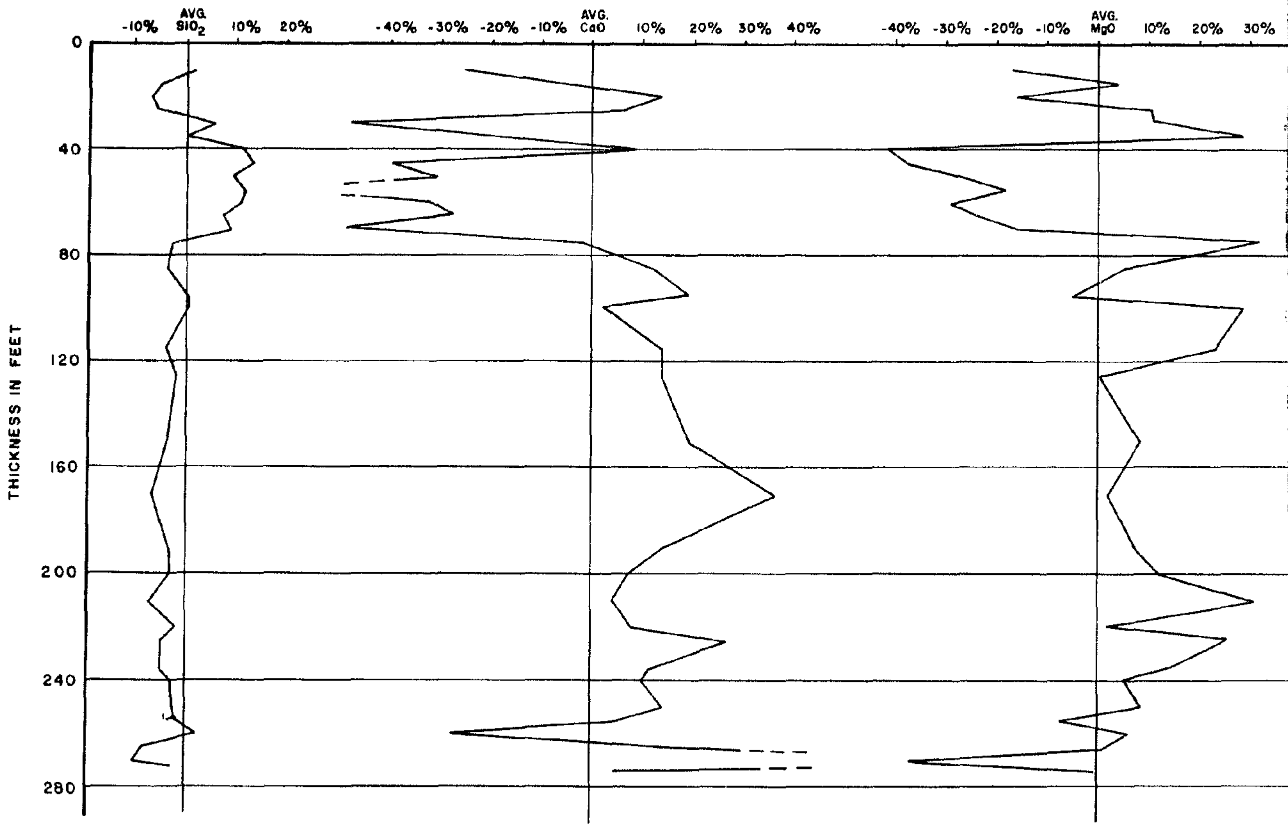


FIGURE 6
CHEMICAL COMPOSITION OF SCALES CREEK FLOW
DIAMOND DRILL HOLE SL 5


-20% -10% AVG. Al_2O_3 10% 20%
-40% -30% -20% -10% AVG. Na_2O 10% 20% 30% 40% 50% 60%
-70% -60% -50% -40% -30% -20% -10% AVG. K_2O 10% 20% 30%

EK FLOW


10% 20% 30% 40% 50% 60%
-70% -60% -50% -40% -30% -20% -10% AVG. K_2O 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%



THICKNESS IN FEET
0
40
80
120
160
200
240
280
-10%
AVG. SiO_2
10%
20%
-40%
-30%
-20%
-10%
AVG. CaO
10%
20%
30%
40%
-40%
-30%
-20%
-10%
AVG. MgO
10%
20%
30%

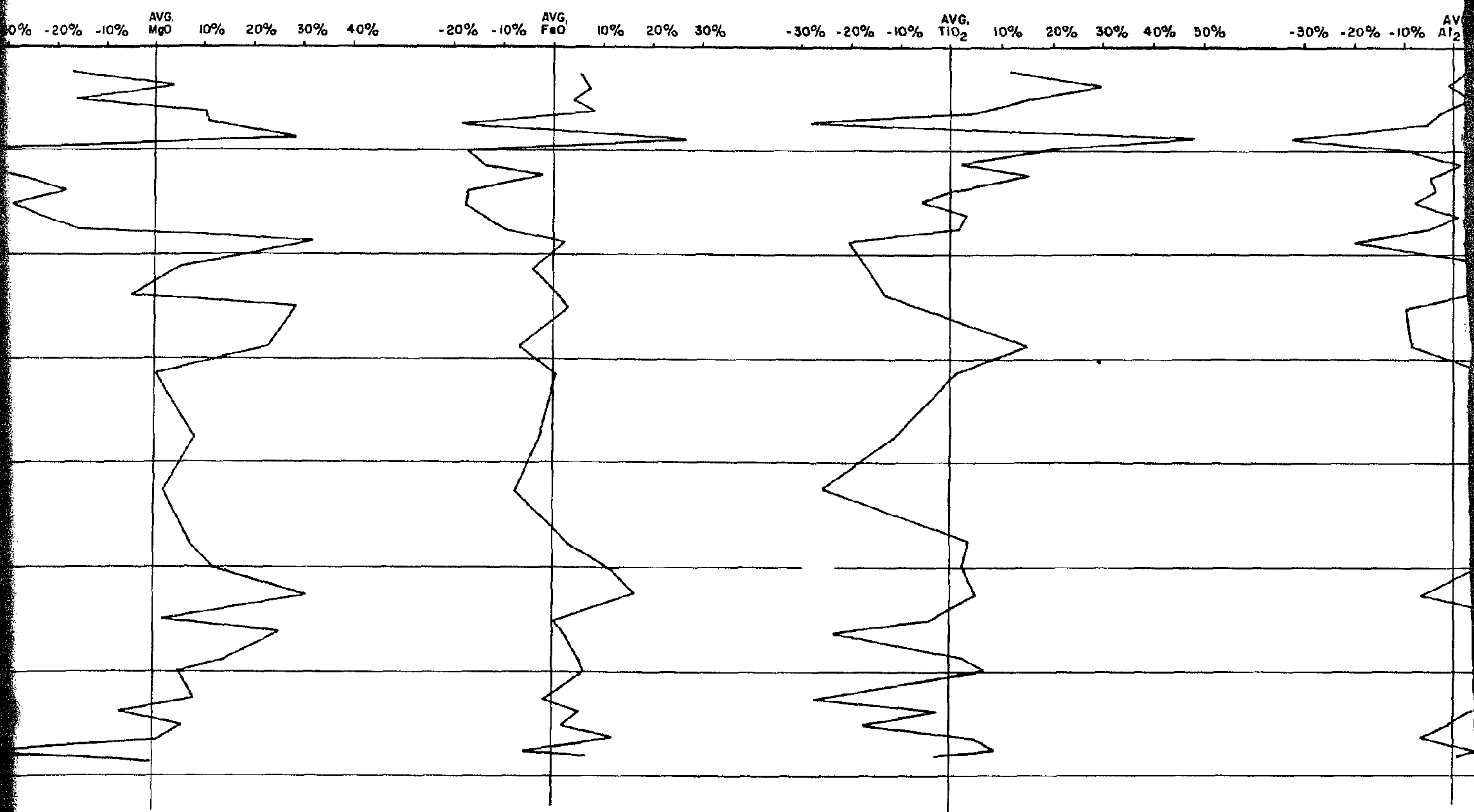


FIGURE 7
CHEMICAL COMPOSITION OF SCALES CREEK FLOW
DIAMOND DRILL HOLE NK 3

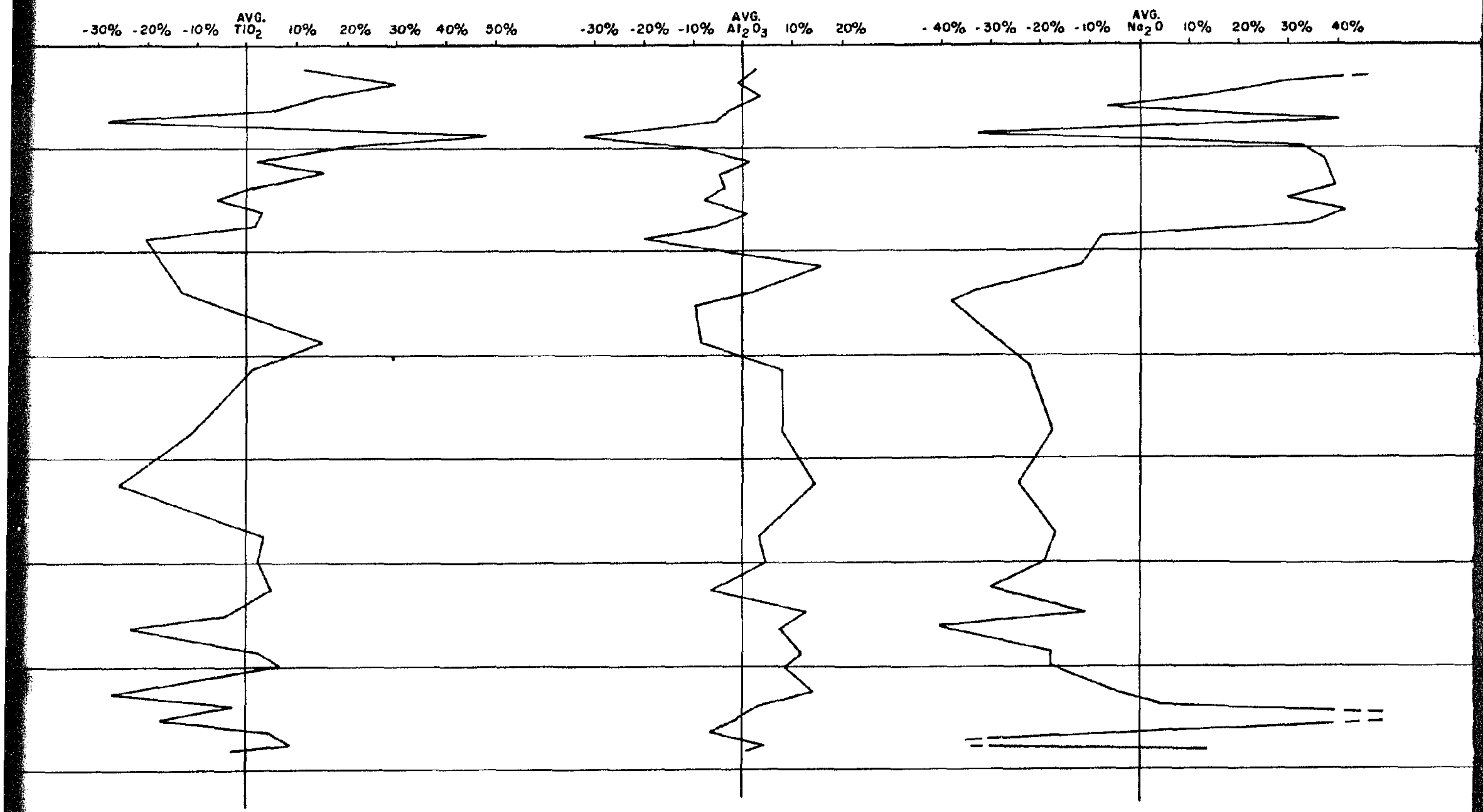
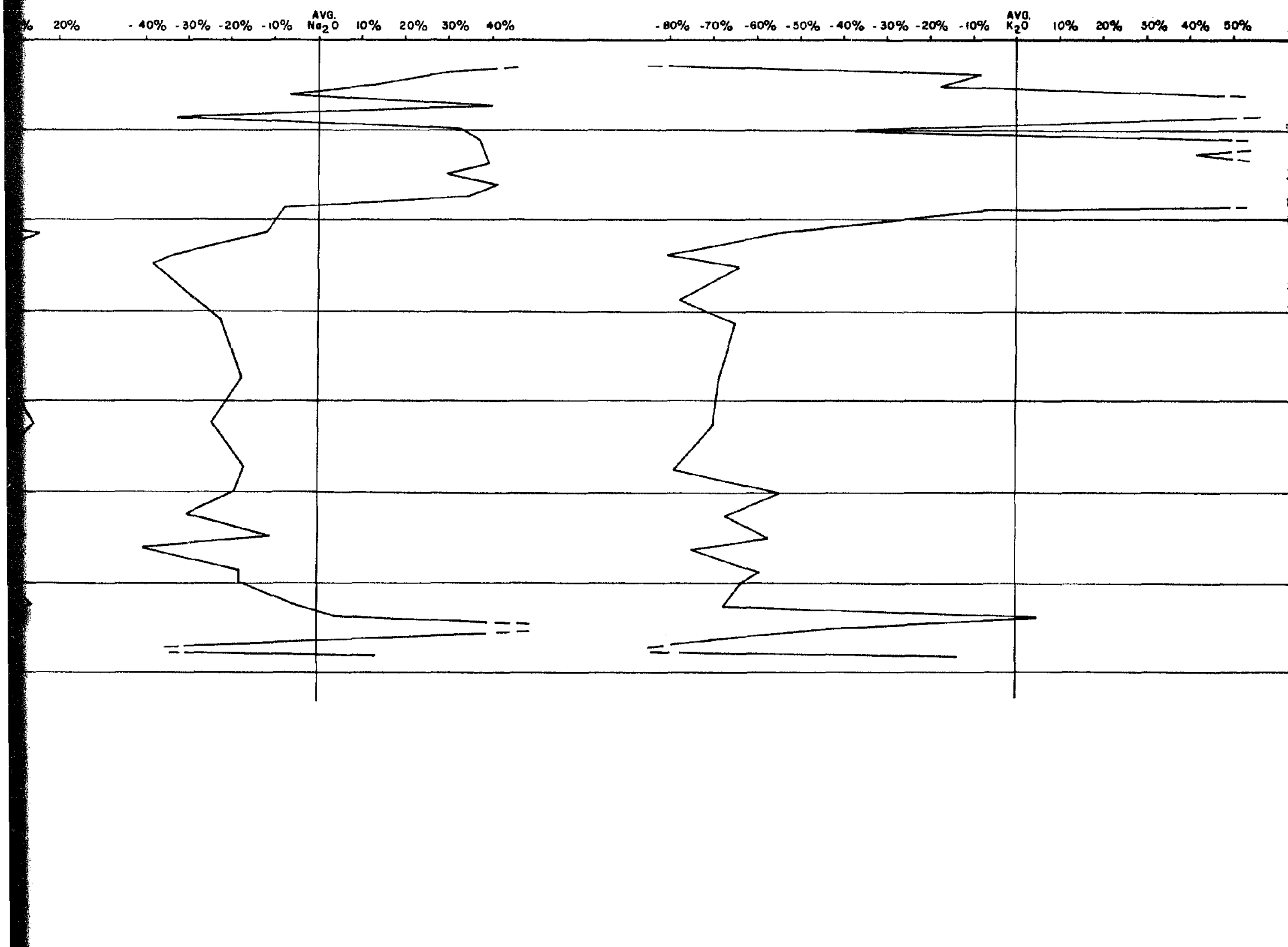


FIGURE 7
L COMPOSITION OF SCALES CREEK FLOW
DIAMOND DRILL HOLE NK 3


% 20%
- 40% -30% -20% -10% AVG. Na2O 10% 20% 30% 40%
-80% -70% -60% -50% -40% -30% -20% -10% AVG. K2O 10% 20% 30% 40% 50%

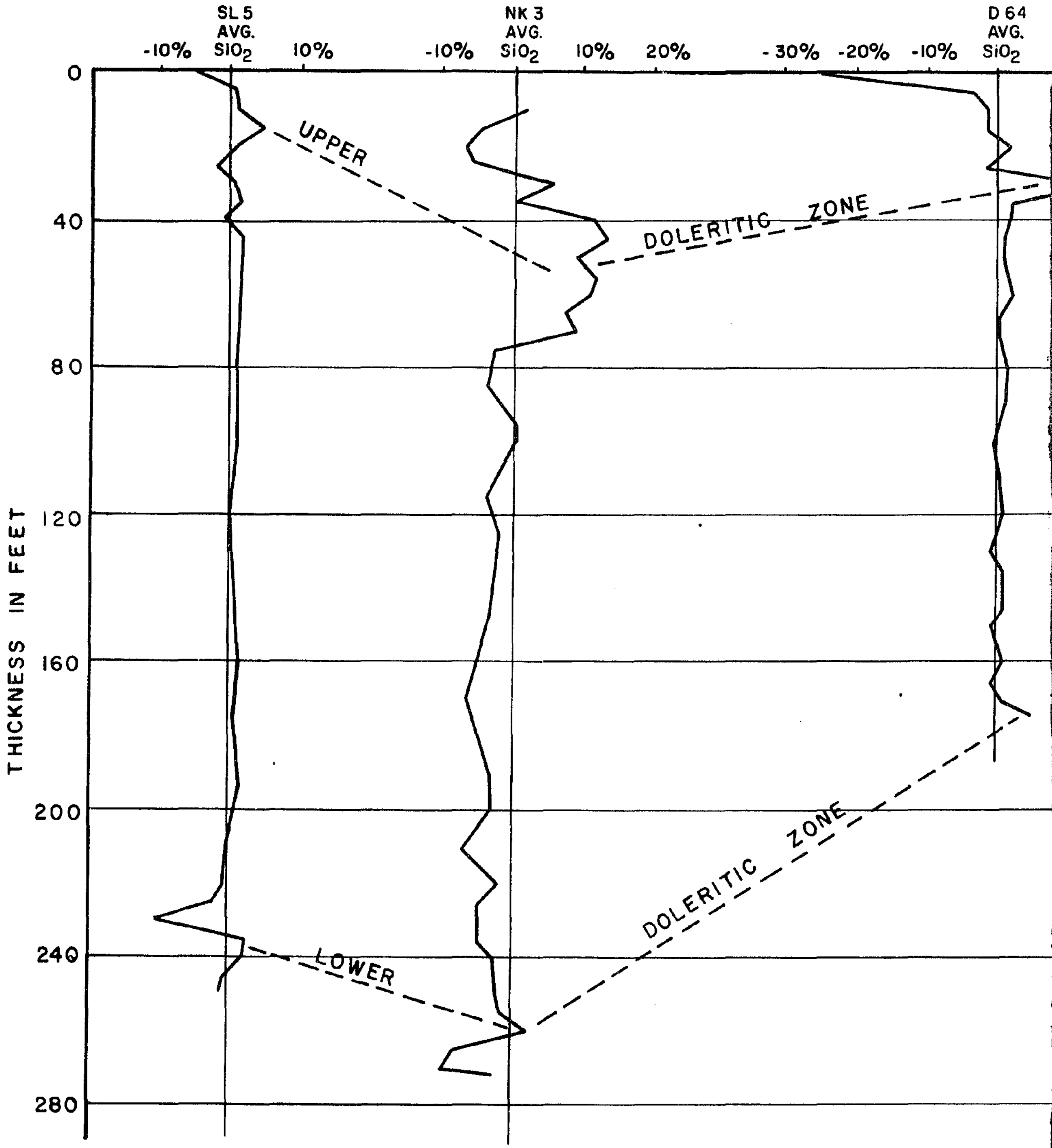


FIGURE 8
SILICON OXIDE VARIATION IN SCALES CREEK FLOW

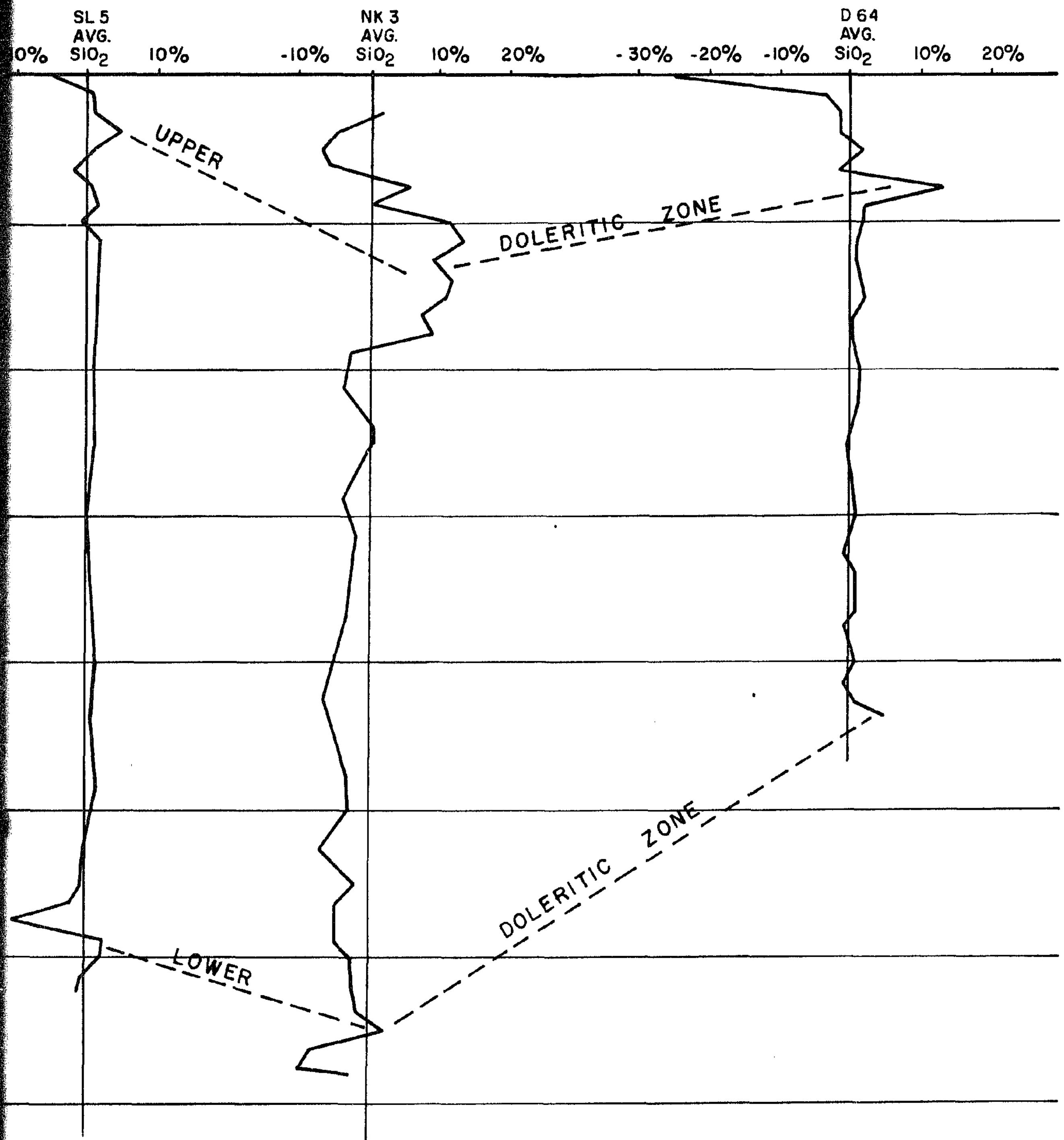
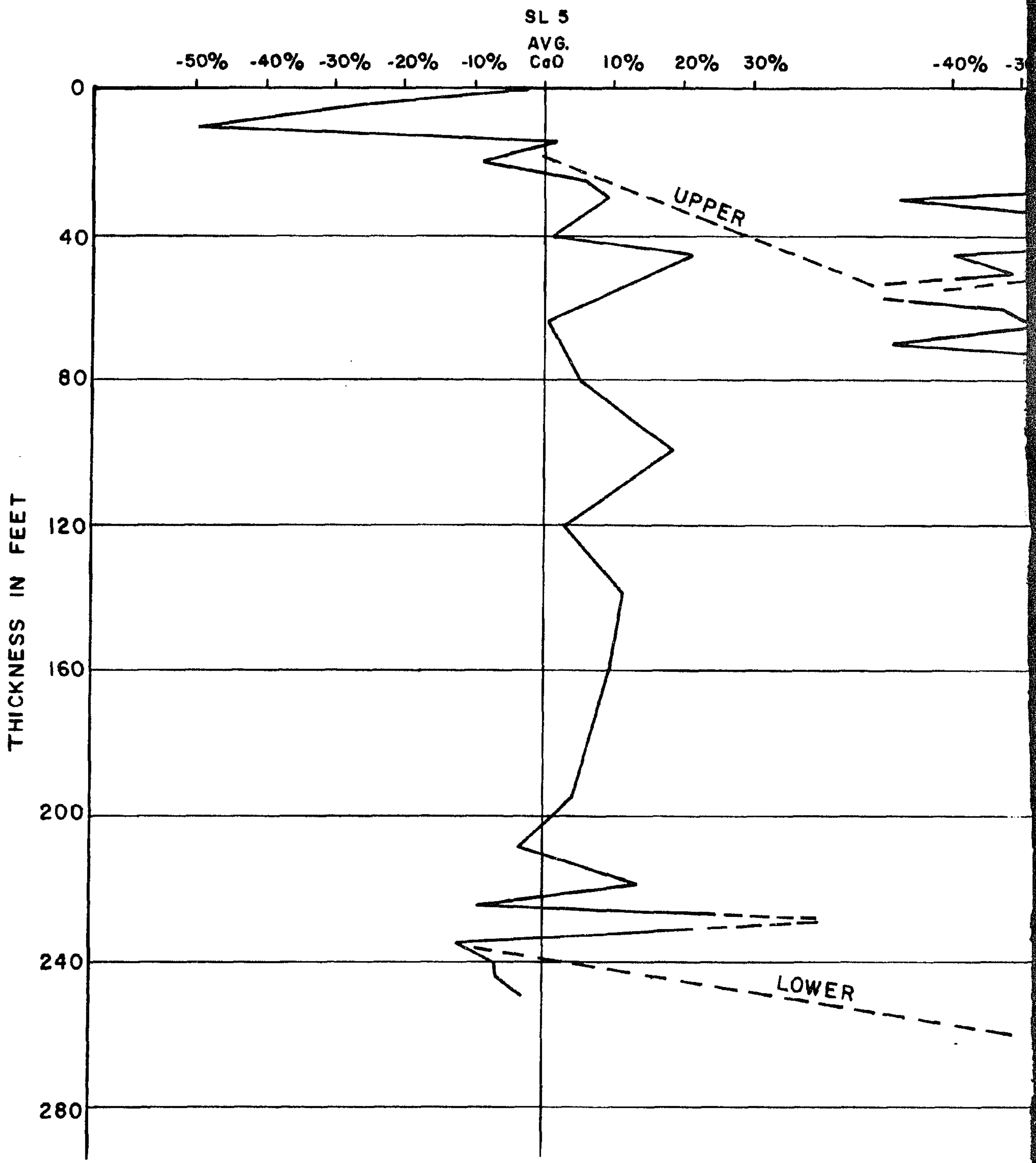


FIGURE 8
SILICON OXIDE VARIATION IN SCALES CREEK FLOW



CALCIUM OXIDE

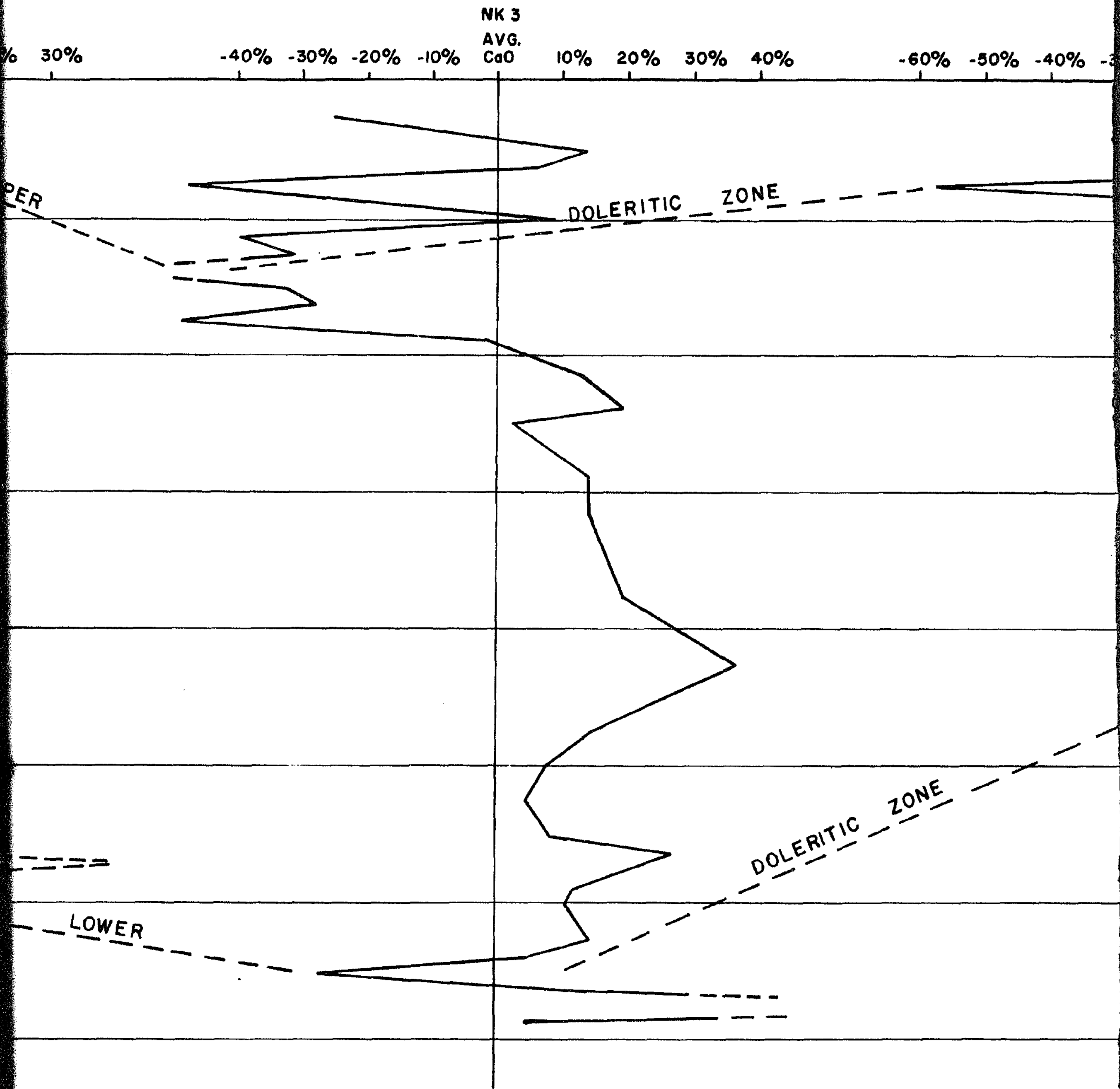
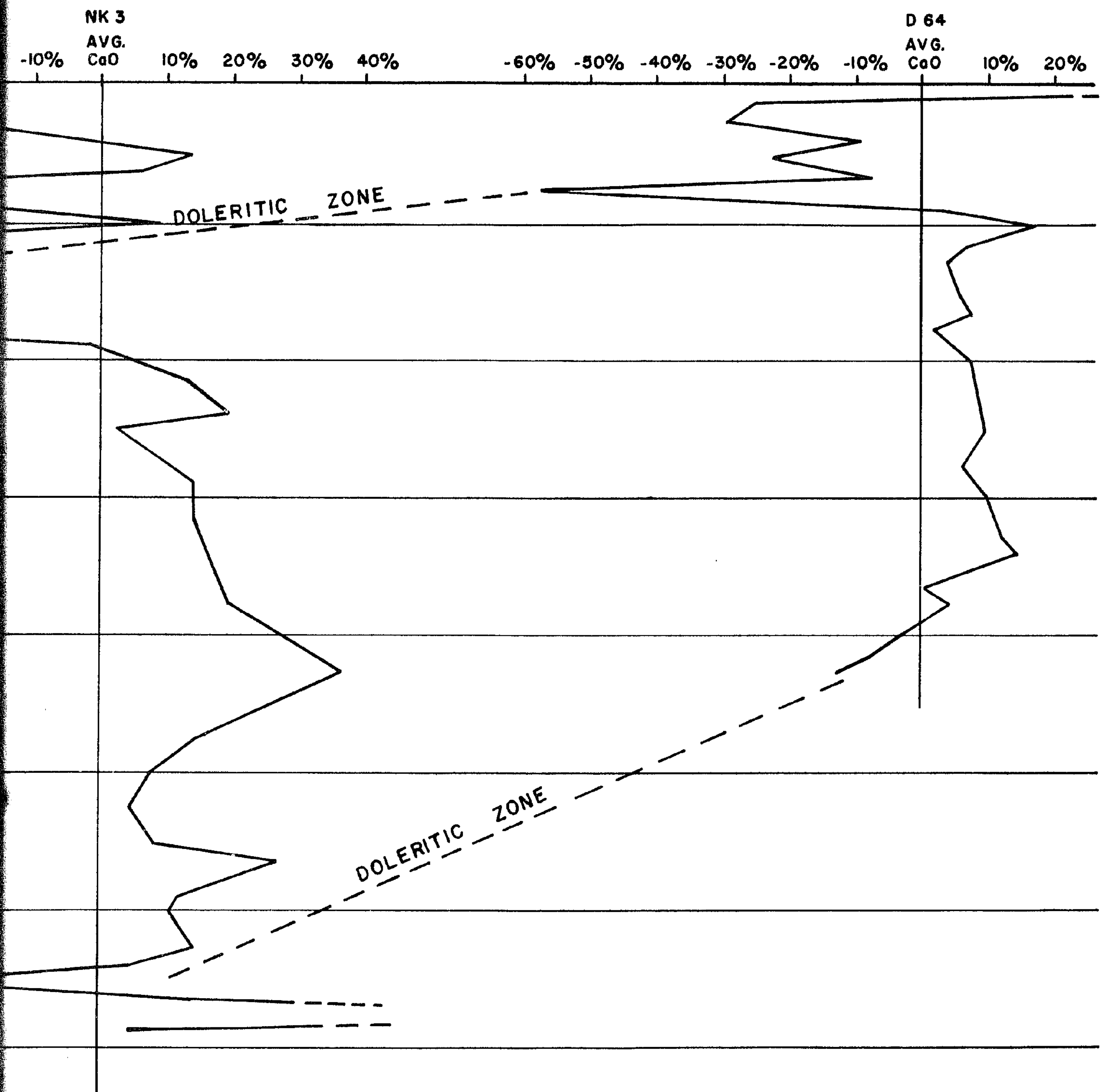
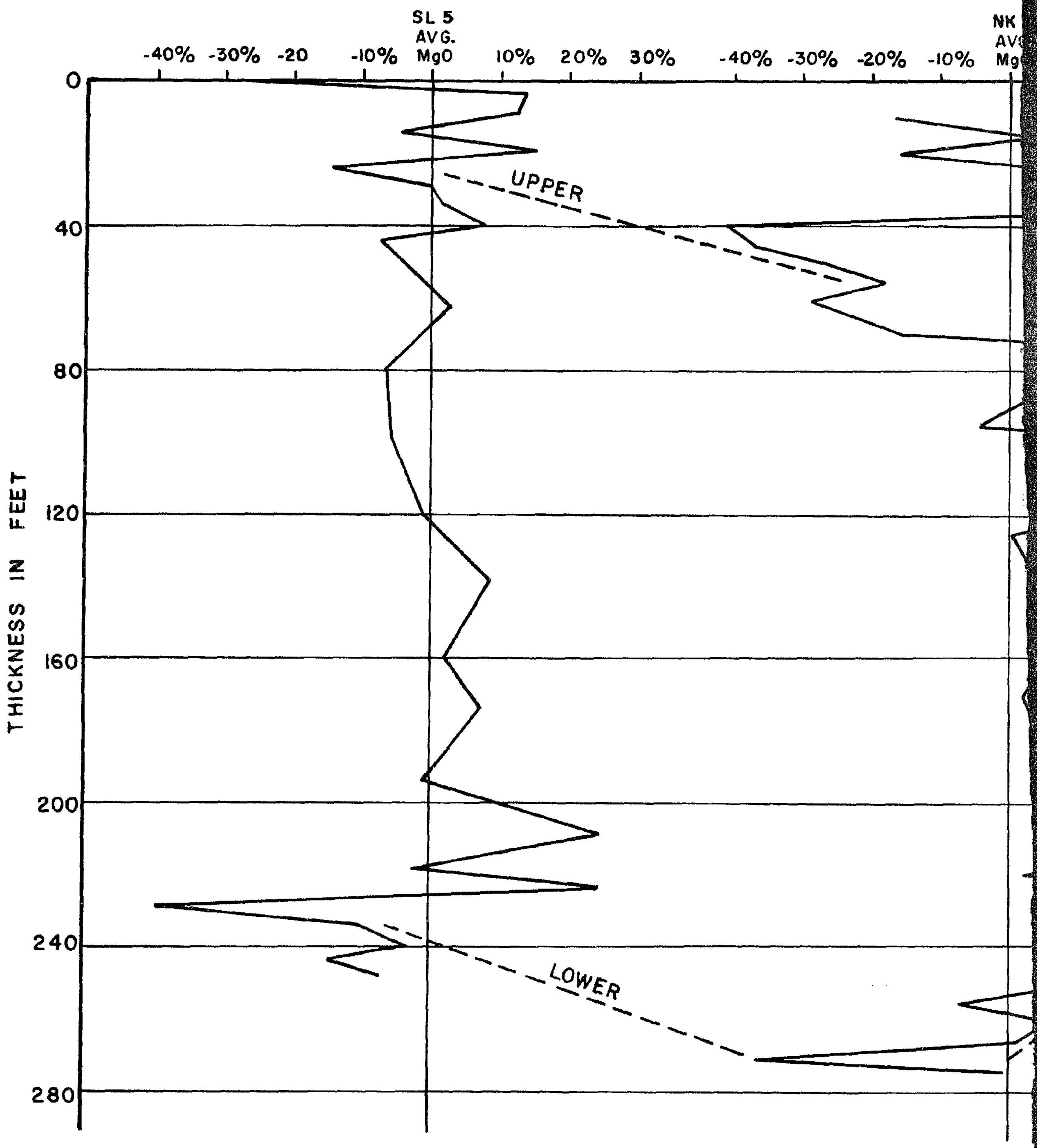


FIGURE 9
CALCIUM OXIDE VARIATION IN SCALES CREEK FLOW



GURE 9
TION IN SCALES CREEK FLOW



FIGURE

MAGNESIUM OXIDE VARIATION I

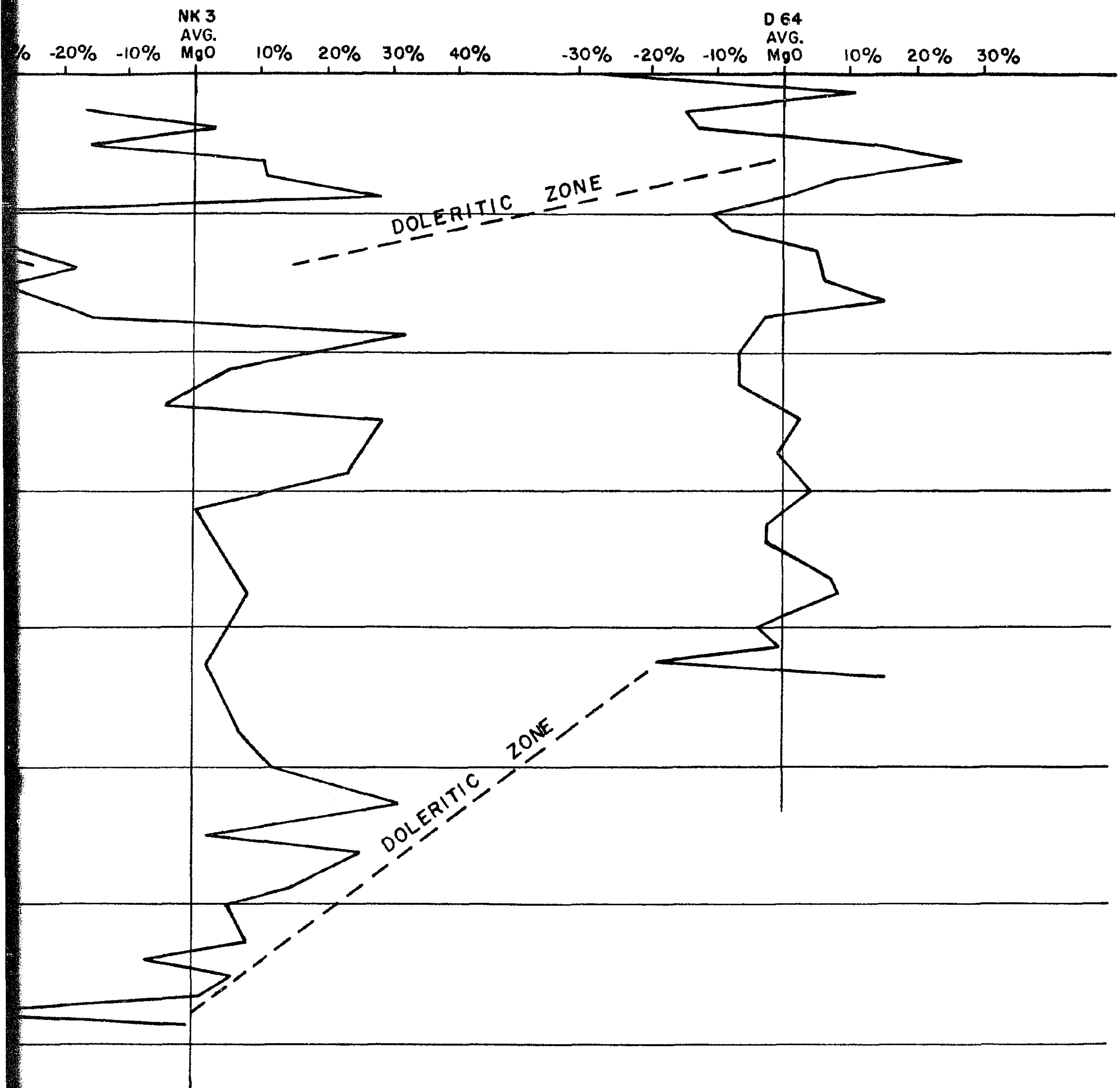


FIGURE 10

VARIATION IN SCALES CREEK FLOW

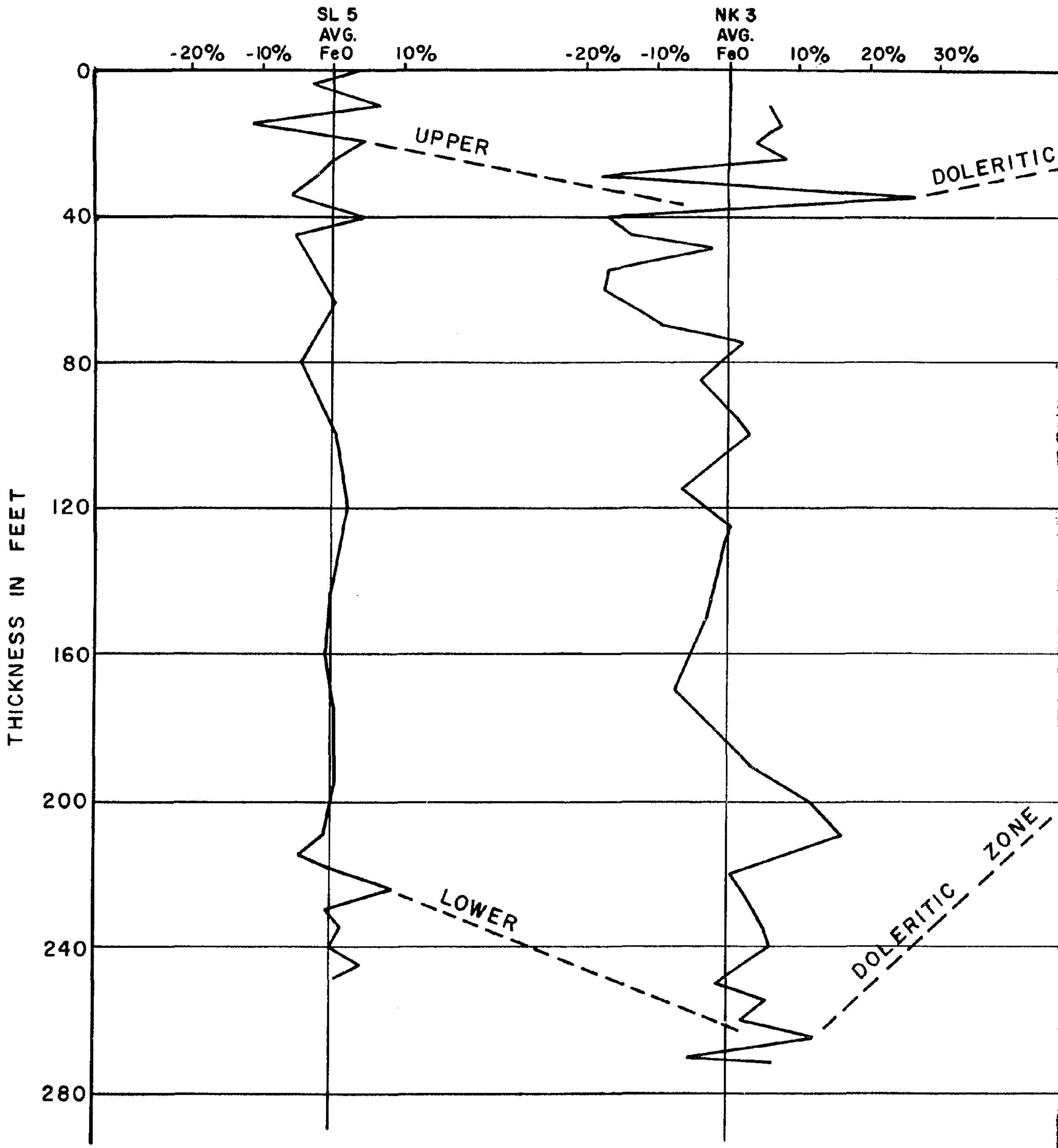


FIGURE II

IRON OXIDE VARIATION IN SCALES CREEK FLOW

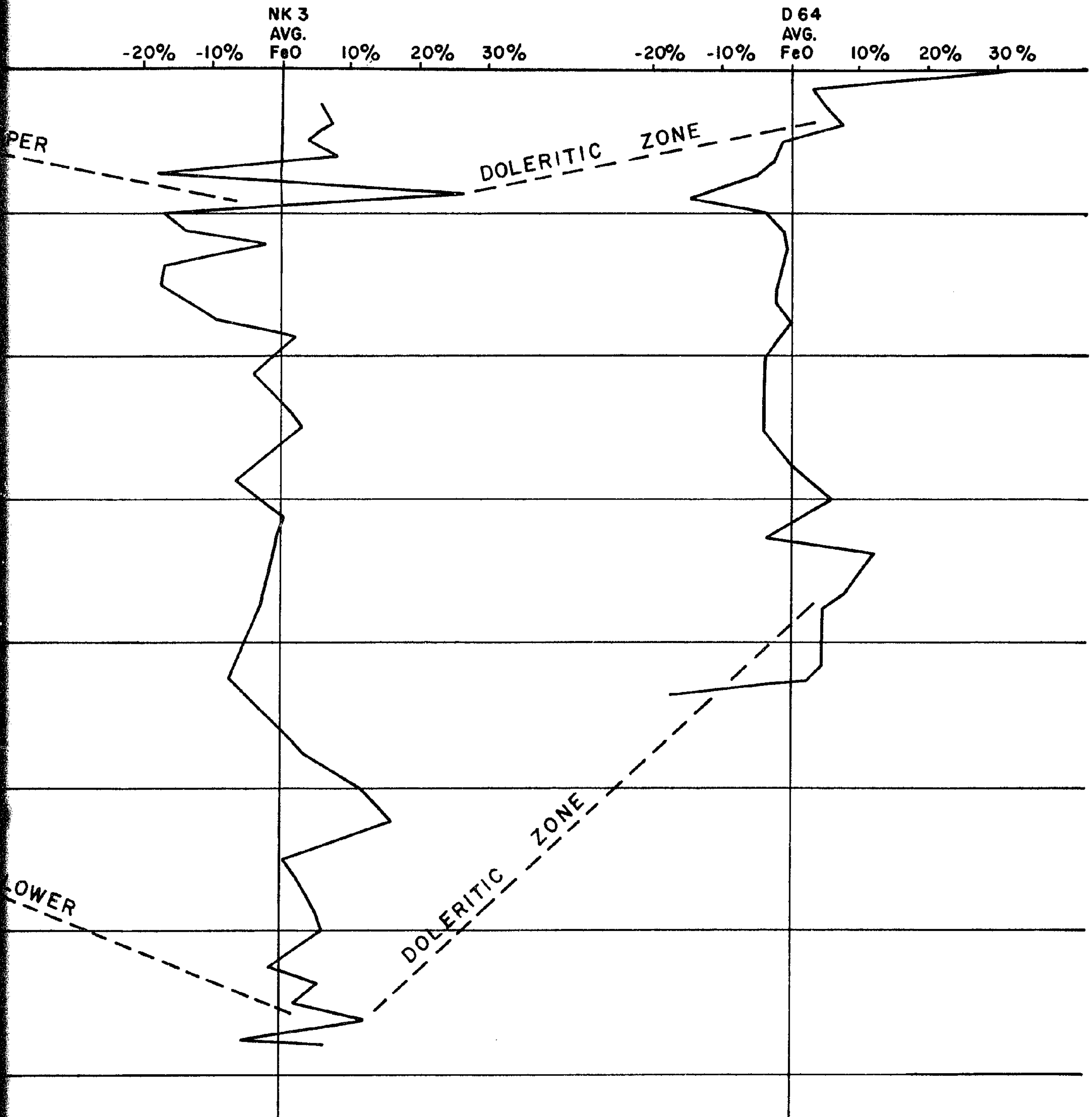


FIGURE II

DE VARIATION IN SCALES CREEK FLOW

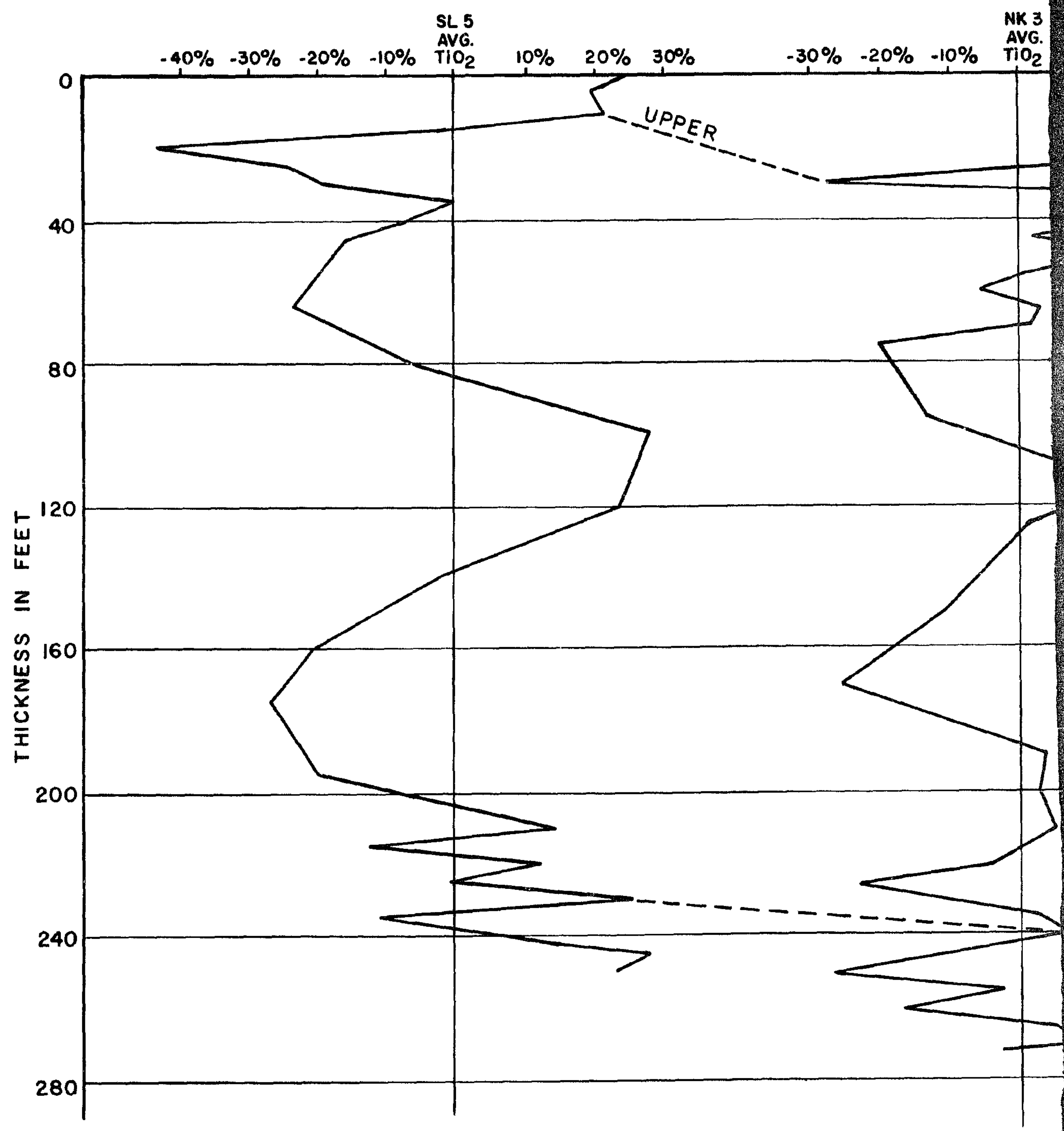


FIGURE 1

TITANIUM OXIDE VARIATION IN

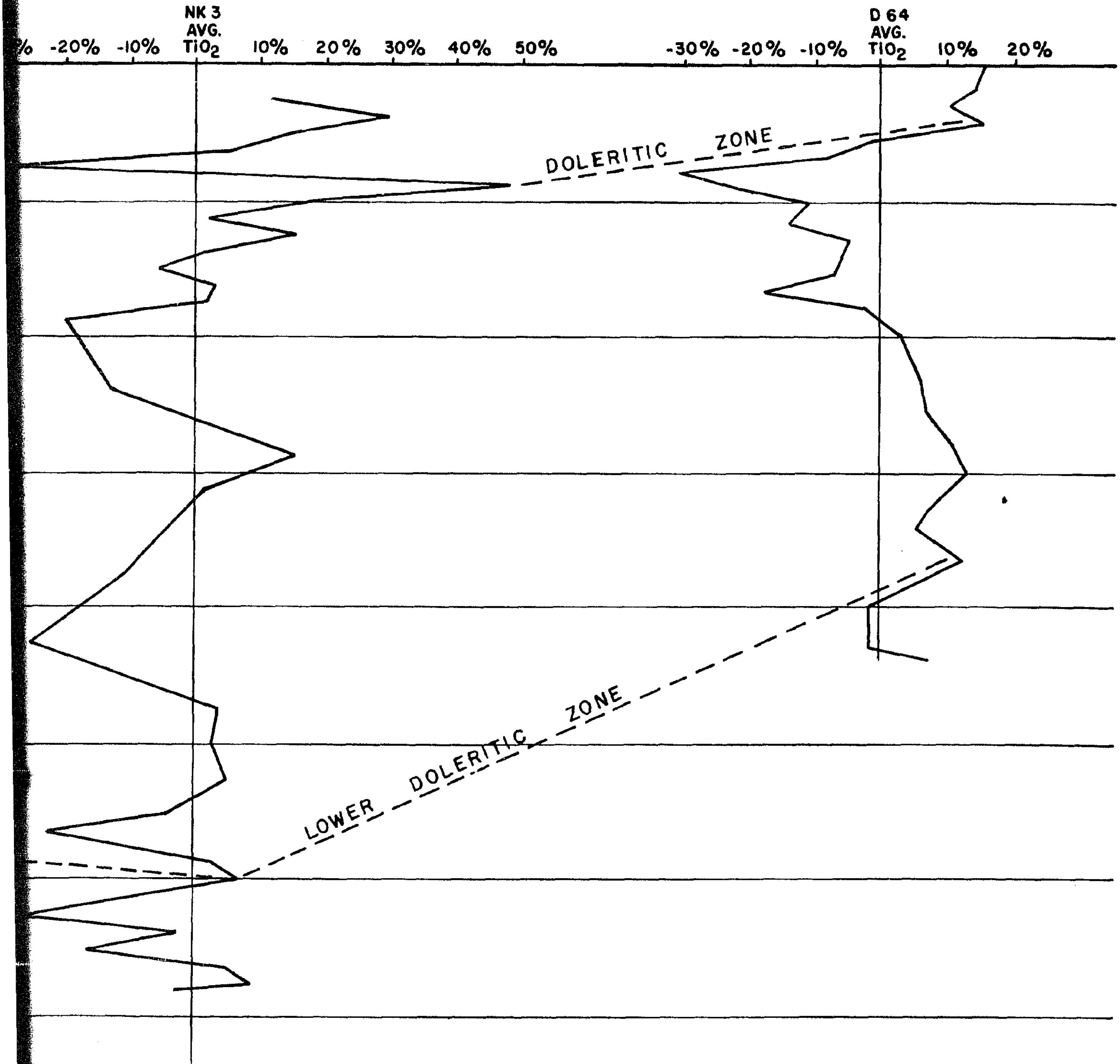


FIGURE 12

VARIATION IN SCALES CREEK FLOW

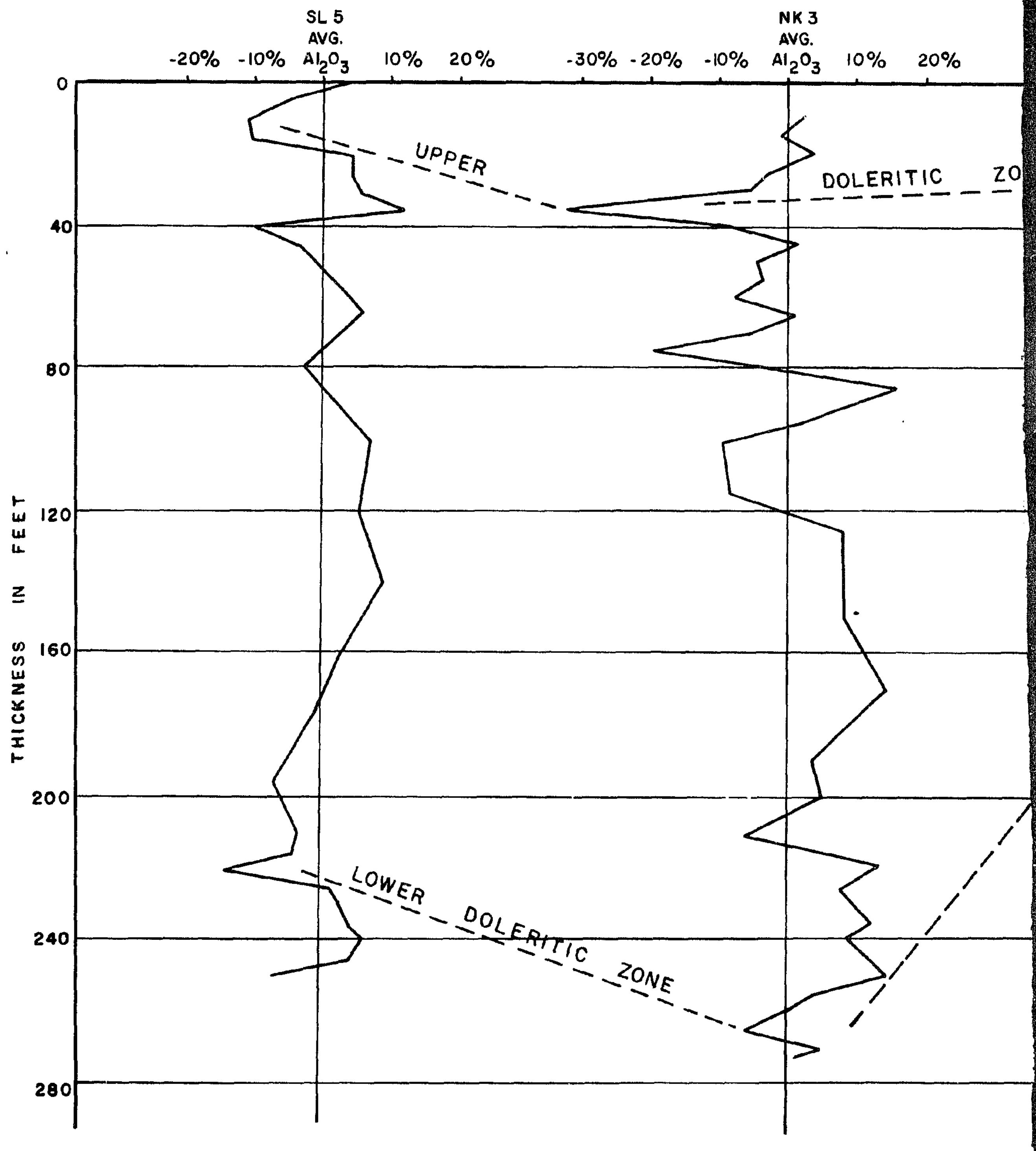


FIGURE 13

ALUMINUM OXIDE VARIATION IN SCALES CREEK

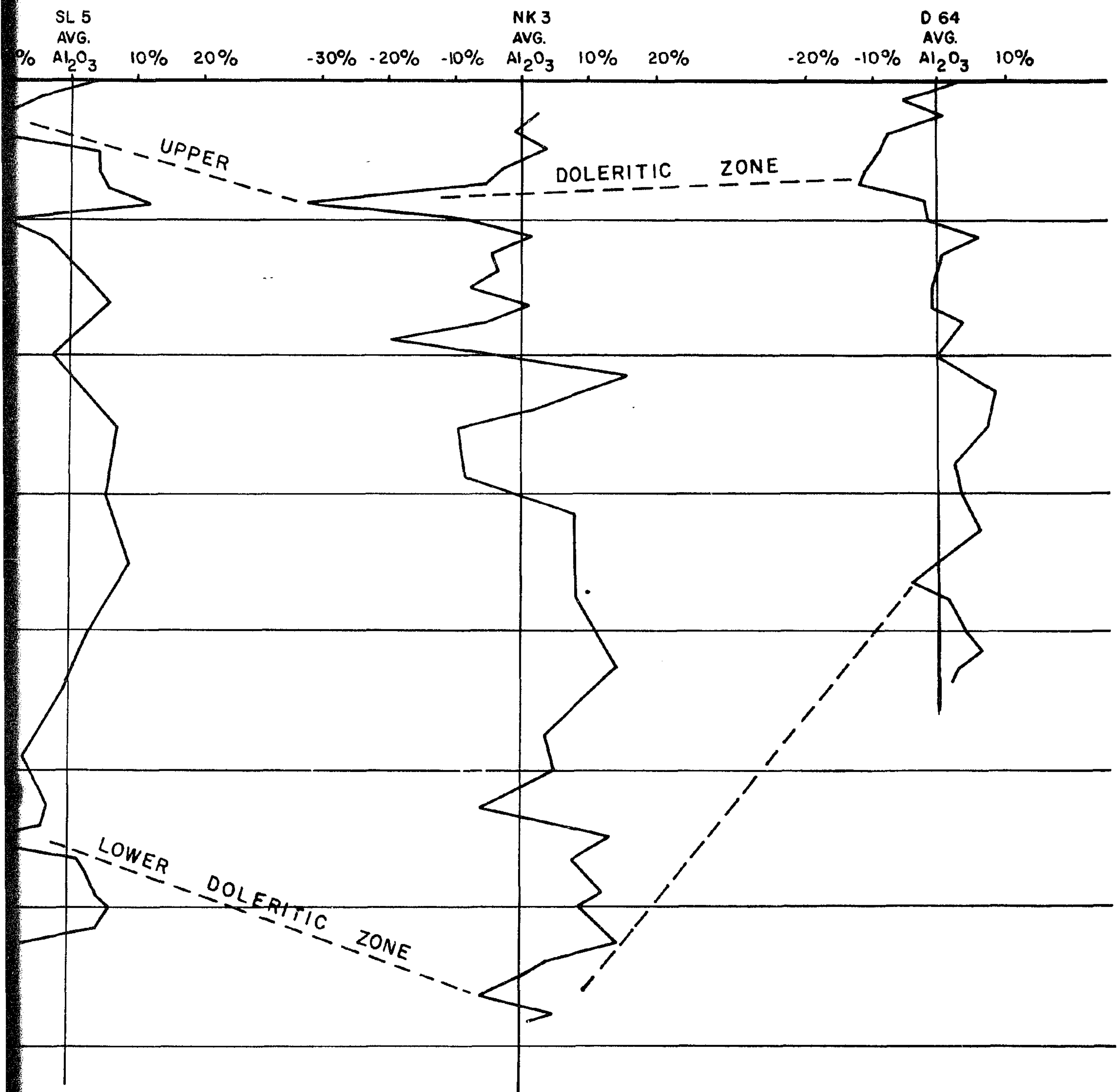
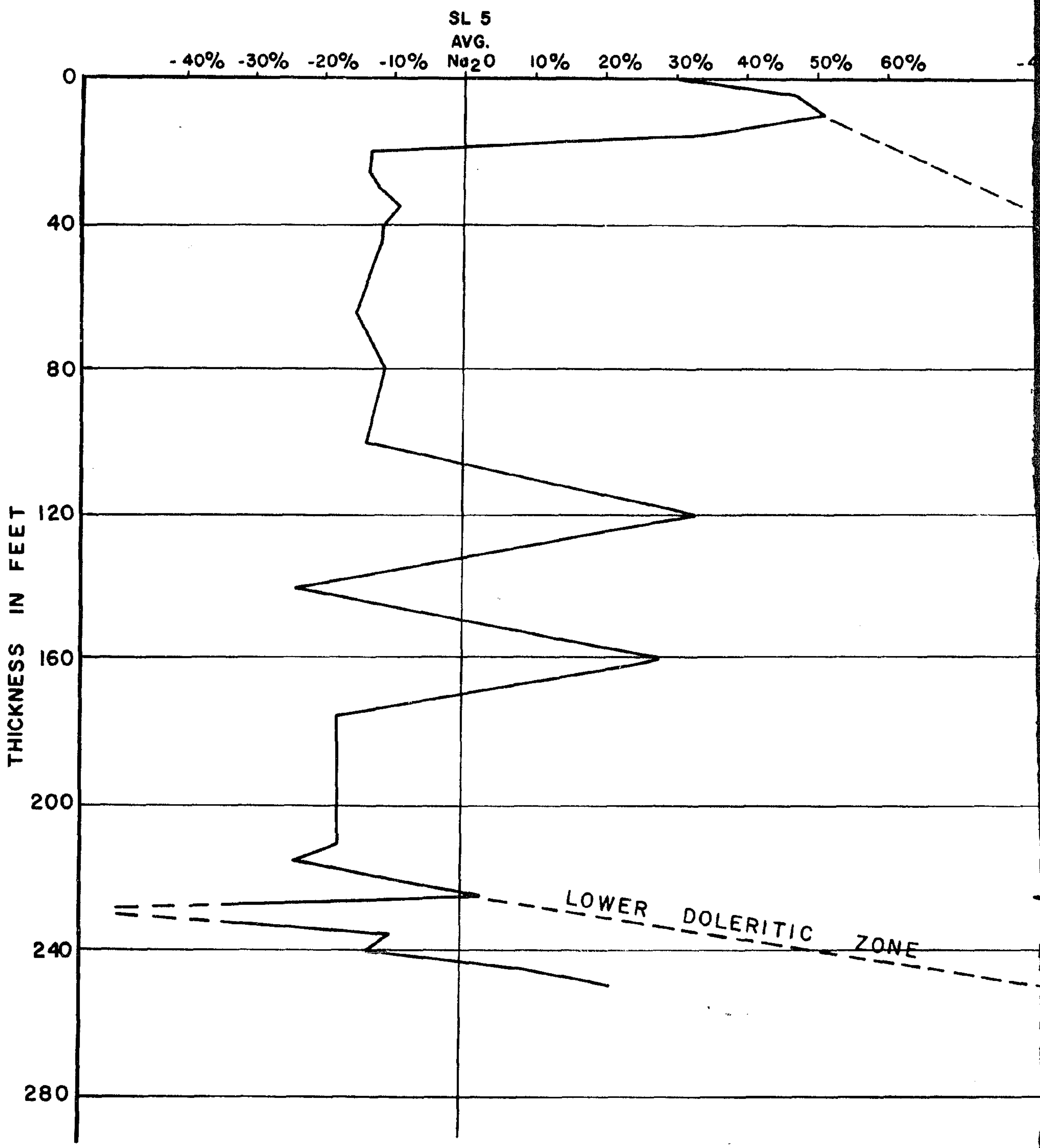


FIGURE 13

ALUMINUM OXIDE VARIATION IN SCALES CREEK FLOW


SL 5
AVG.
Na_2O
-40%
-30%
-20%
-10%
0
10%
20%
30%
40%
50%
60%
THICKNESS IN FEET
0
40
80
120
160
200
240
280
LOWER DOLERITIC ZONE

SODIUM

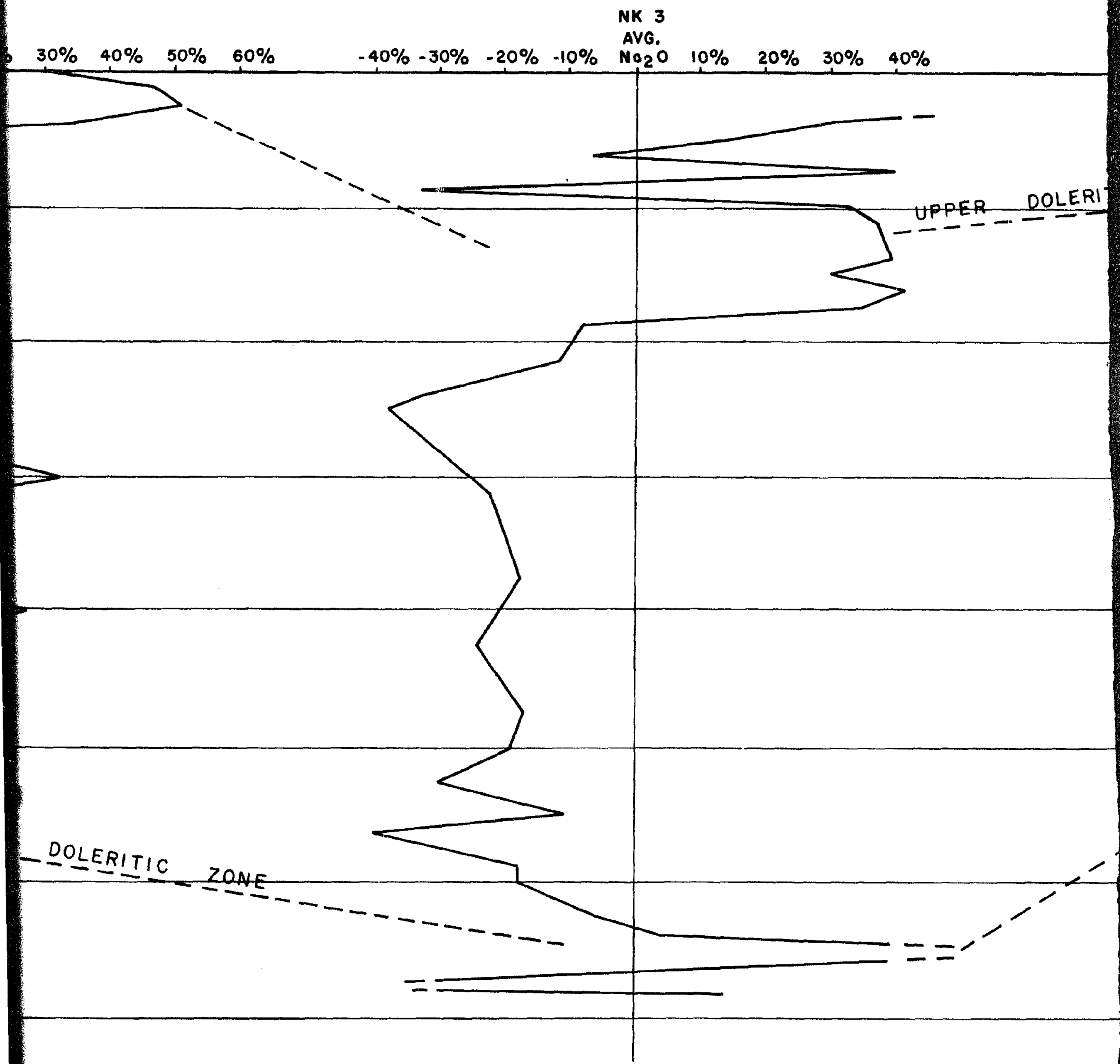
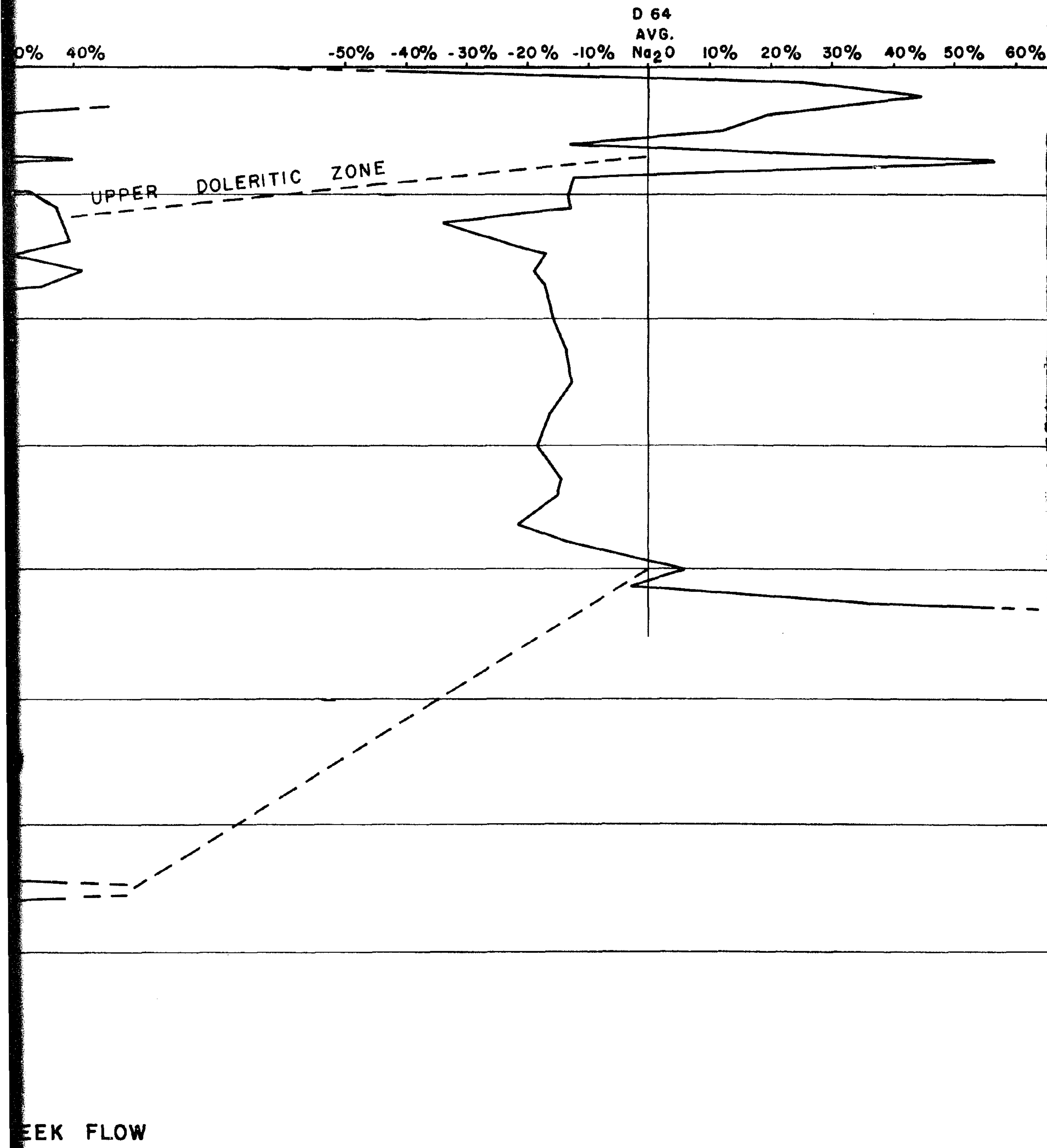
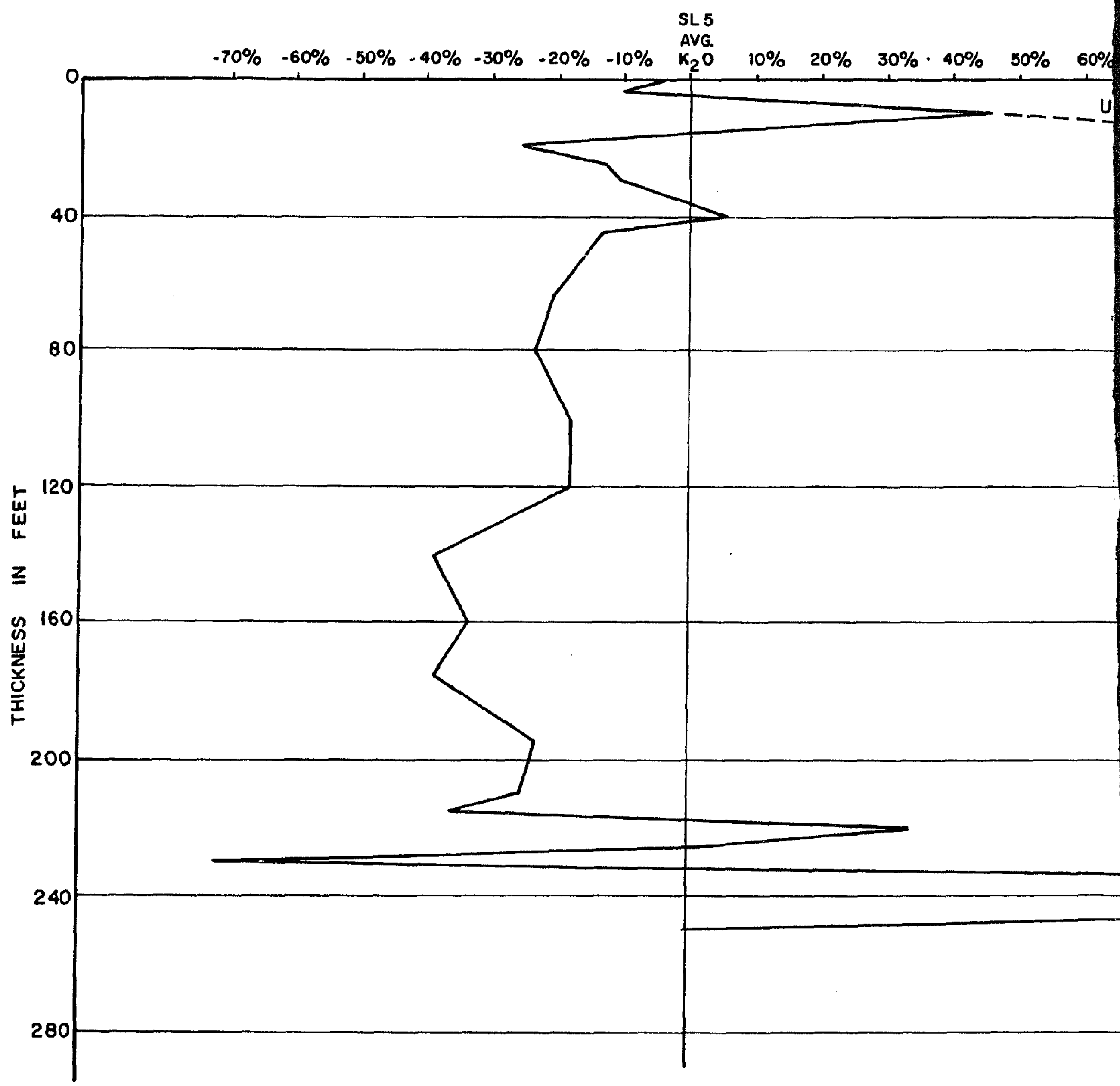
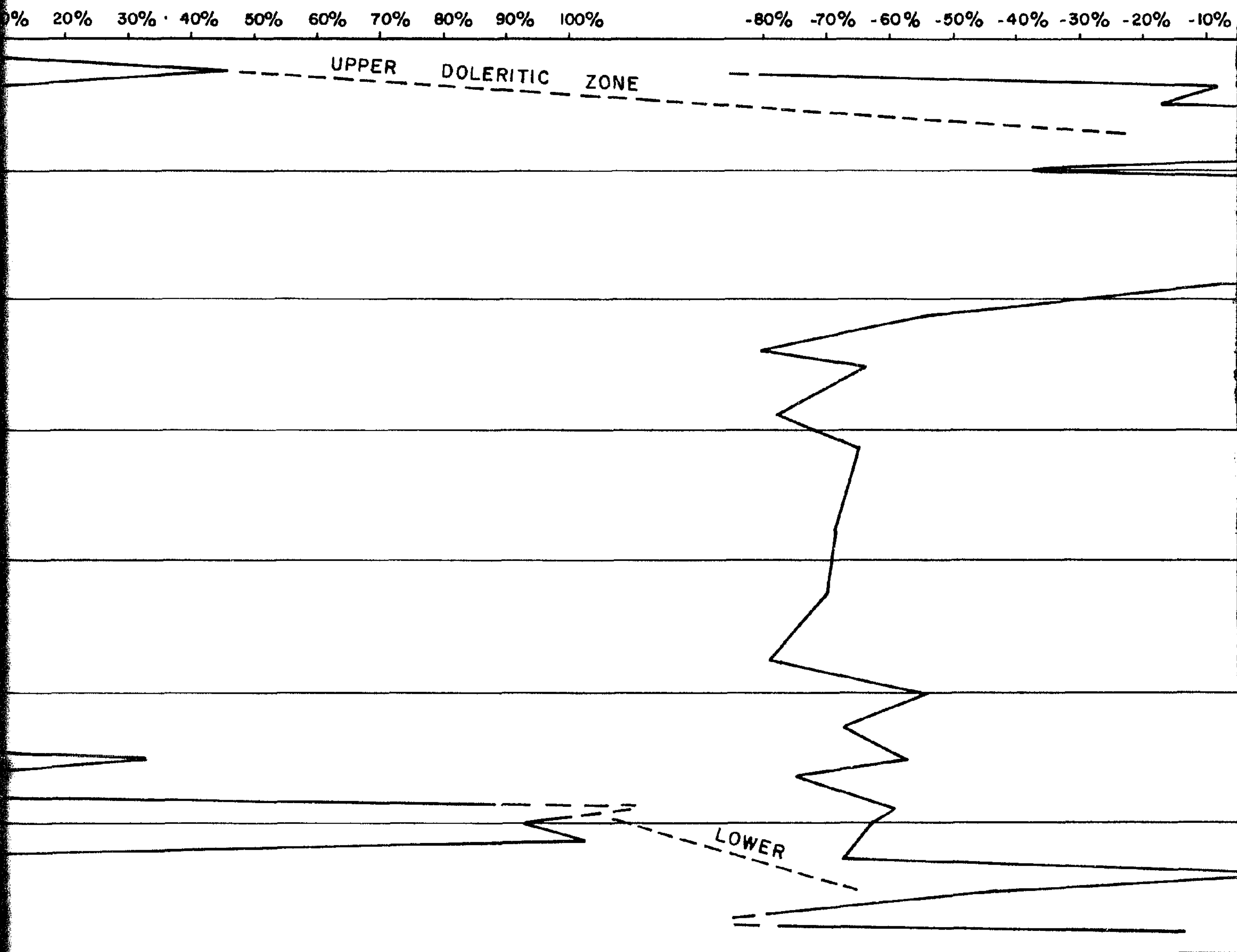


FIGURE 14

SODIUM OXIDE VARIATION IN SCALES CREEK FLOW


D 64
AVG.
Na_2O
0% 40% -50% -40% -30% -20% -10% 10% 20% 30% 40% 50% 60%
UPPER DOLERITIC ZONE
EEK FLOW


SL 5
AVG.
K_2O
-70%
-60%
-50%
-40%
-30%
-20%
-10%
10%
20%
30%
40%
50%
60%
THICKNESS IN FEET
0
40
80
120
160
200
240
280



FIGURE

POTASSIUM OXIDE VARIATION IN

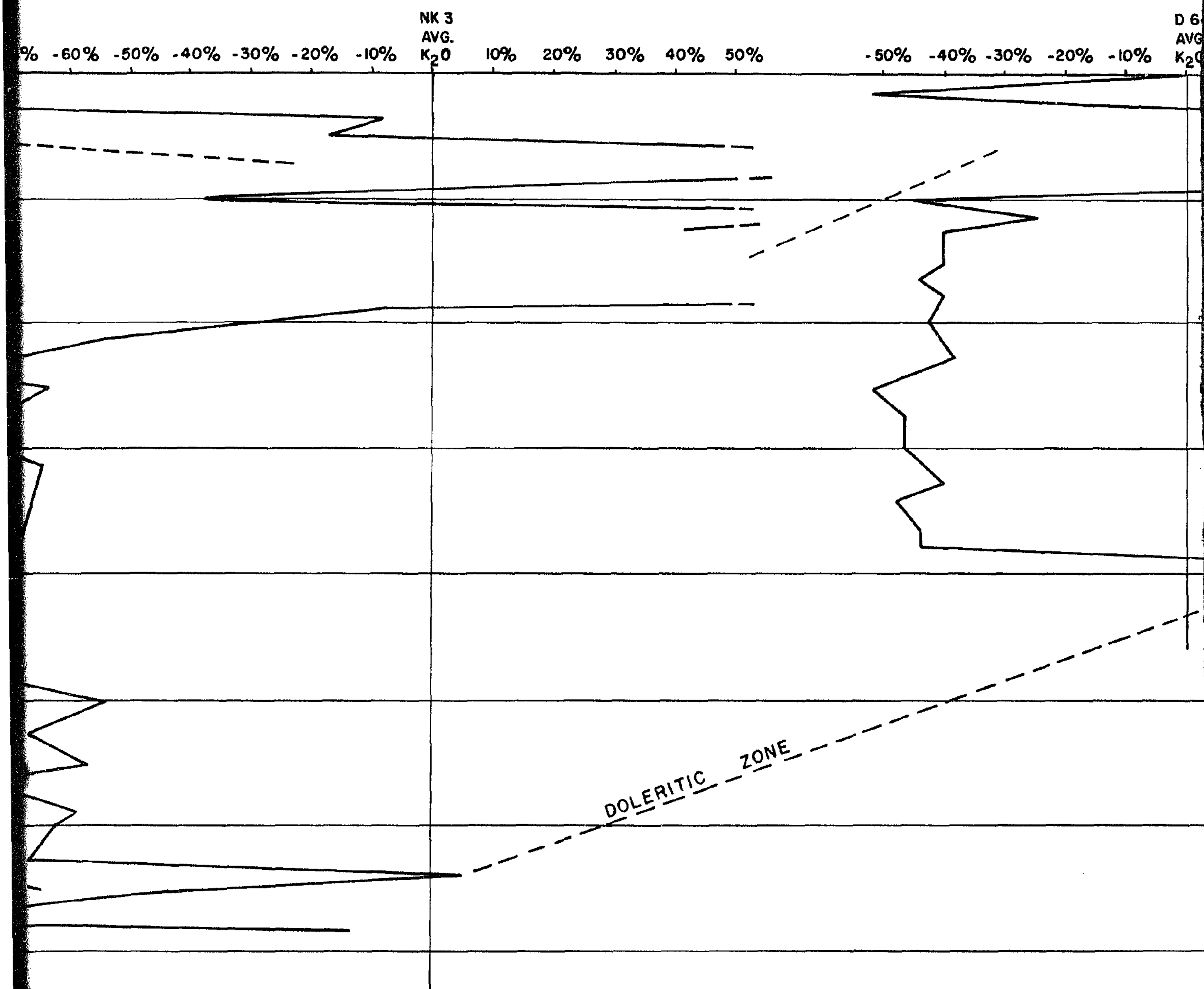
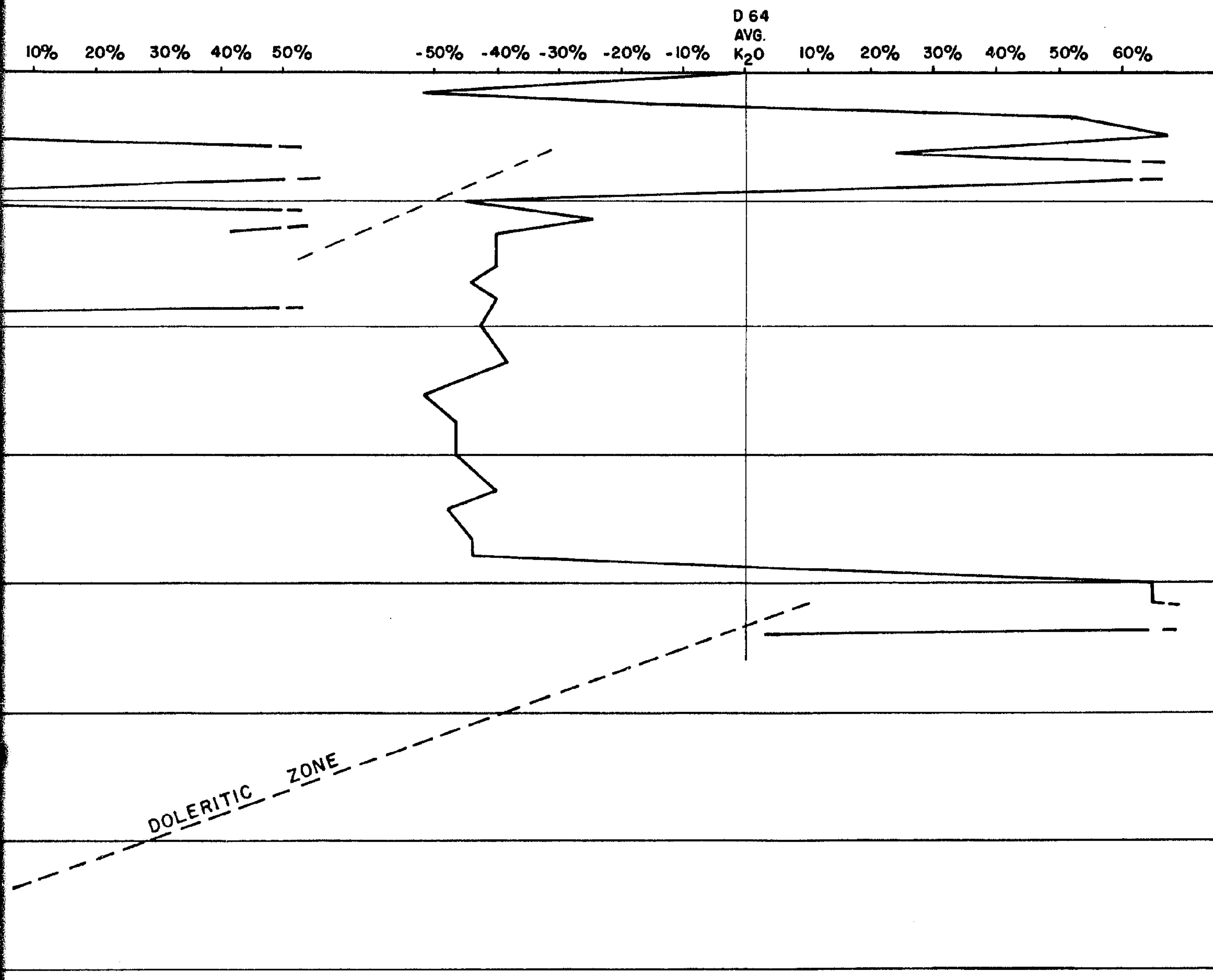


FIGURE 15
ASSIUM OXIDE VARIATION IN SCALES CREEK FLOW



ES CREEK FLOW

Pyroxene Analyses

Originally several hundred pyroxene samples were density separated and it was intended to concentrate on their chemistry in this study. Pyroxenes were chosen because the lack of diverse composition and the existence of only one phase renders the plagioclase somewhat less valuable than the pyroxenes in studying basaltic magma variation. However, due to difficulty in obtaining pure samples and the impossibility of ever separating the pigeonite and augite, the study was limited to two sets of minerals.

Sixteen samples of pyroxenes were separated from the St. Louis 5 drill hole and partial chemical analyses were made on them (Table 5). The peaks of the graph of the FeO/MgO ratio (Figure 16) representing the highest FeO/MgO ratios correspond with thin sections that have both pigeonite and augite present. This agrees with the work of Hess (1941).

An attempt was made by the author, assisted by Milo Nielsen of the Buick Motor Division, to apply an electron microscope to the study of the pyroxene grains. Semi-quantitative results were obtained on one grain (Photo 1). However, great difficulty was encountered due to the electrical charges on the grain surface (Photo 2). Eventually, by coating the grain with gold the charge could be removed and the grain analyzed. This method would be suggested for further study since the mixed pyroxene grains could then be individually analyzed. It must be cautioned that such a procedure is slow and very expensive.

Eight pyroxene samples were separated from the Osceola 3 diamond

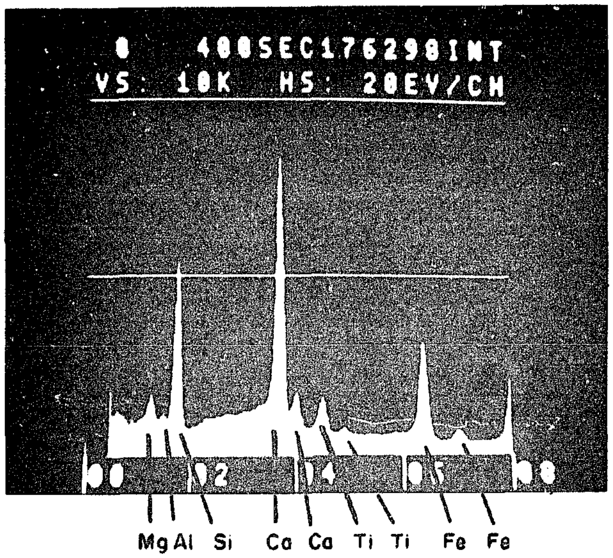


Photo 1. Semi-Quantitative Analysis of an Augite Grain.

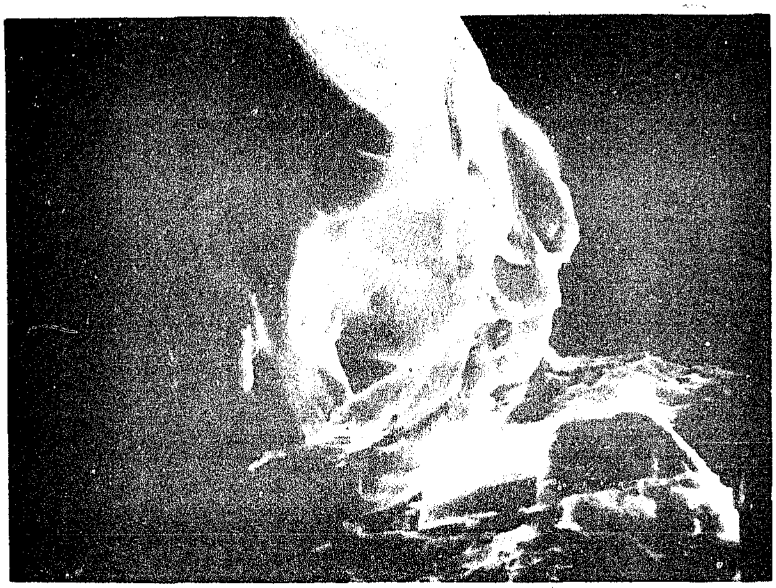


Photo 2. Electron Microscope Picture of Augite Grain Showing Charge Effect on Surface, X1000.

Table 5. Chemical Analyses of the Pyroxenes from the Scales Creek Flow, Diamond Drill Hole SL5.

Sample/ Depth	SiO_2	CaO	MgO	FeO	FeO/ MgO
1/0	37.72	22.68	0.76	16.45	21.68
3/10	38.65	13.72	9.93	22.25	2.24
10/45	36.70	9.28	8.05	23.09	2.87
14/64	38.63	14.95	7.94	20.48	2.58
17/80	49.47	19.72	11.22	13.60	1.21
25/120	71.67	18.12	14.01	14.83	1.06
29/140	52.45	15.18	12.51	17.16	1.37
33/160	46.91	17.18	10.61	13.75	1.30
36/175	42.73	16.75	15.40	14.16	0.92
40/195	47.34	16.32	14.70	16.32	1.11
46/225	10.13	18.48	15.00	11.28	0.75
47/230	47.71	17.31	13.55	13.85	1.02
48/235	47.59	17.70	13.39	14.38	1.07
49/240	48.23	17.98	13.07	14.31	1.09
50/245	48.70	17.53	13.32	13.29	0.99
51/249	46.36	17.78	11.80	15.56	1.32

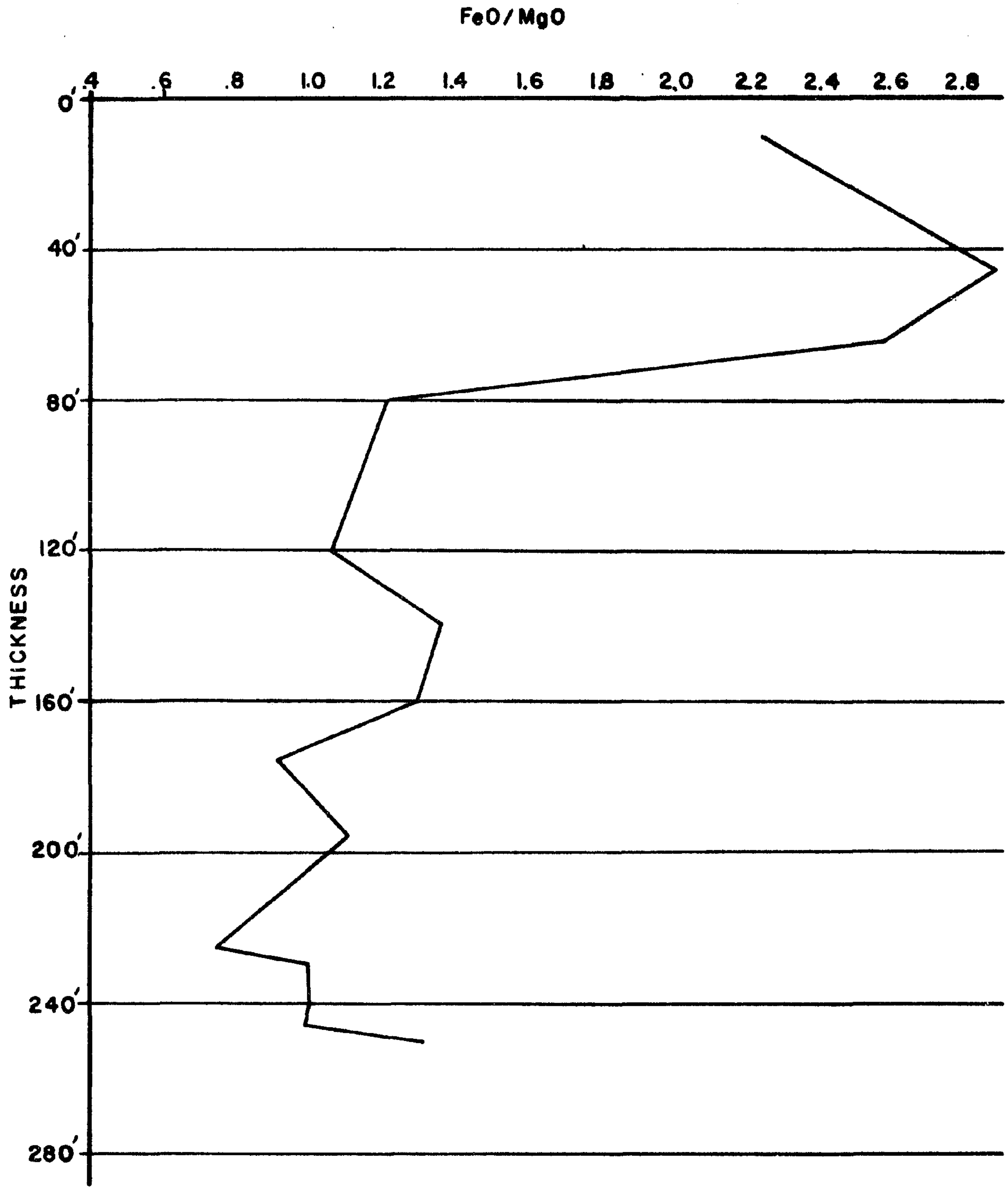


FIGURE 16. FeO/MgO RATIO OF PYROXENES FROM SCALES CREEK FLOW

drill hole which penetrates the Greenstone lava flow where it is only 108 feet thick. These were analyzed (Table 6) and the FeO/MgO ratio was graphed (Figure 17). This ratio tended to increase toward the center of the flow, a trend that was expected from the work of Hess (1941).

Table 6. Chemical Analyses of the Pyroxenes from the Greenstone Flow, Diamond Drill Hole 03.

Sample/ Depth	SiO_2	CaO	MgO	FeO	Al_2O_3	FeO/ MgO
3/10	50.46	18.88	16.17	9.35	6.54	0.578
4/15	55.03	18.35	10.89	9.73	6.00	0.893
8/35	47.55	20.73	17.66	14.36	12.60	0.813
10/45	41.16	17.14	25.61	21.93	10.78	0.856
15/70	48.74	17.96	12.65	12.69	9.34	1.003
17/80	47.05	17.14	13.08	14.08	10.78	1.076
21/100	46.99	17.04	13.59	13.21	10.10	0.972
23/108	49.40	18.39	16.01	10.90	7.11	0.680

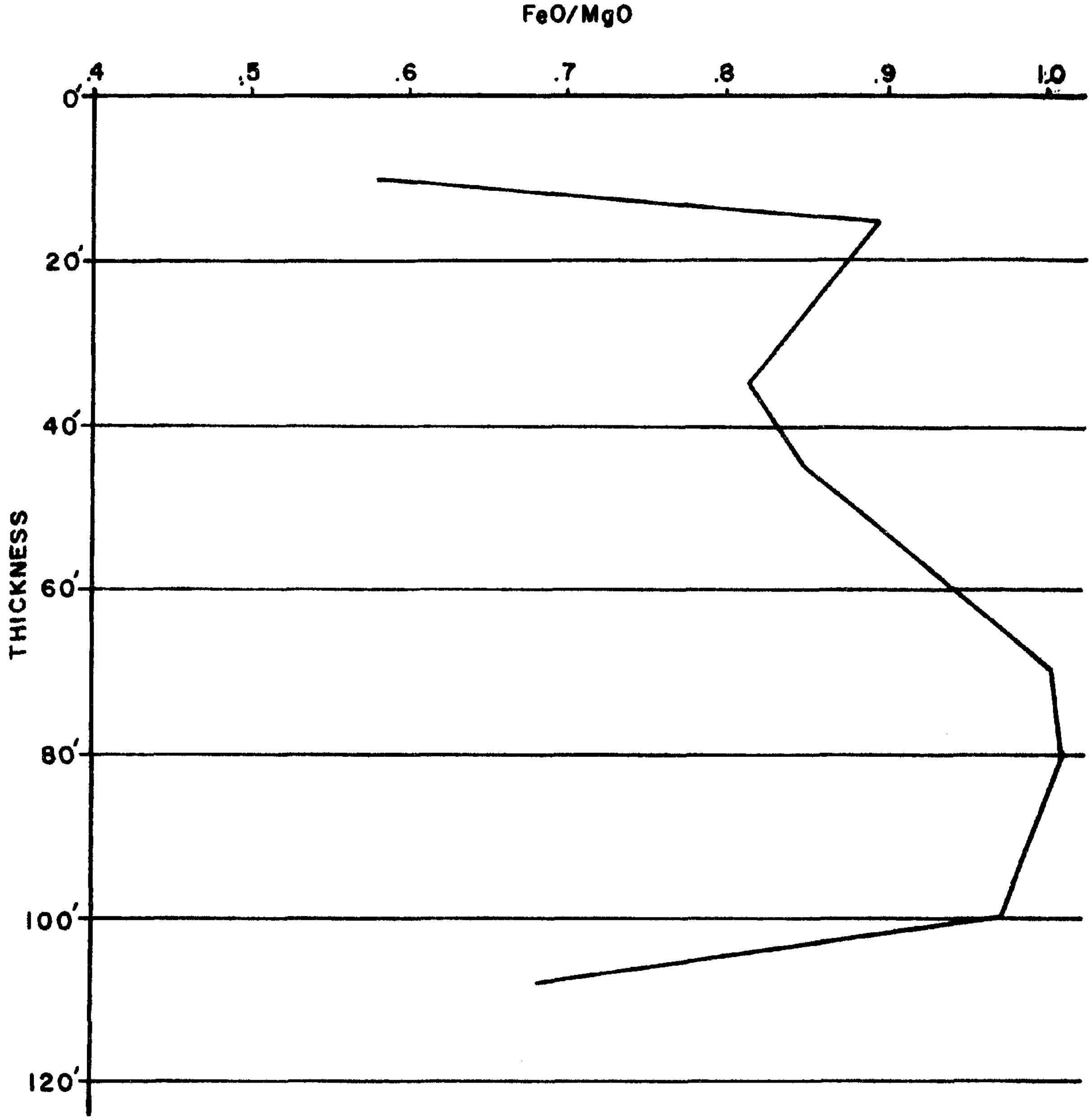


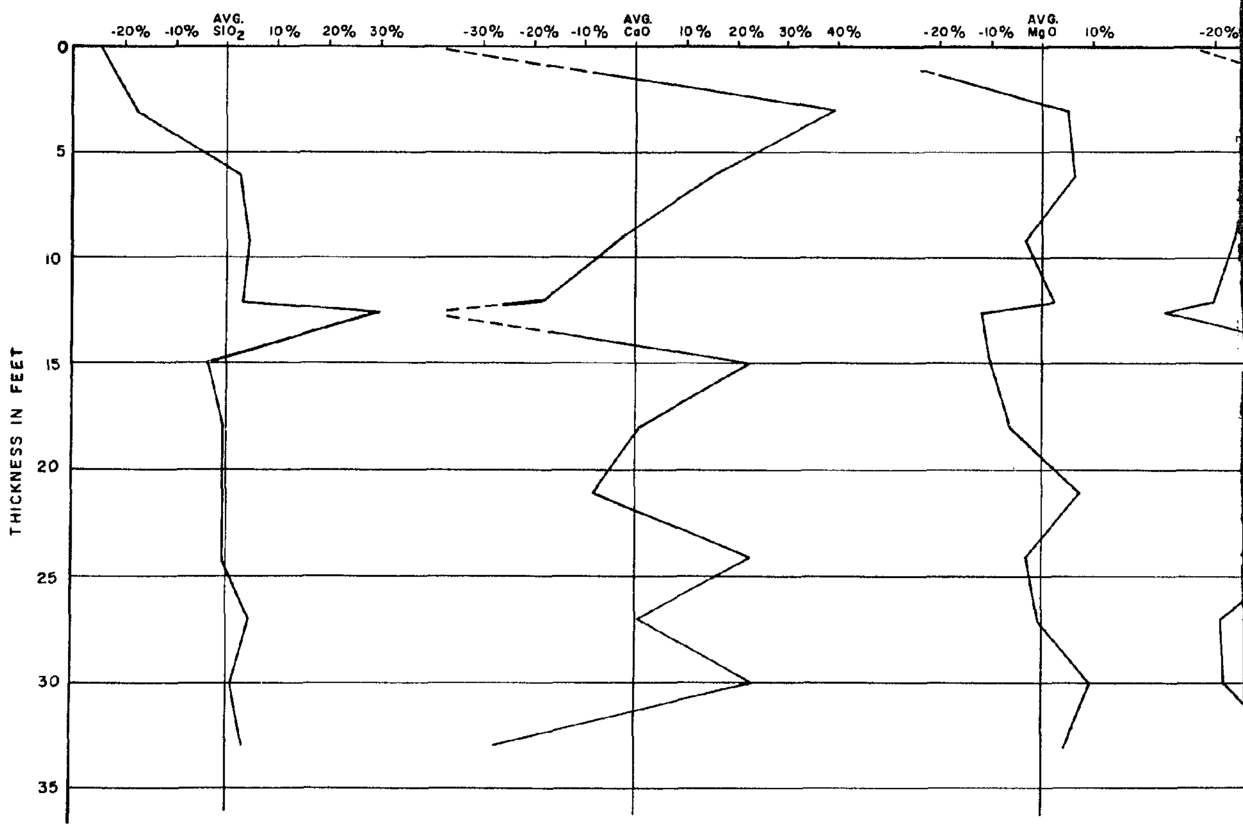
FIGURE 17. FeO/MgO RATIO OF PYROXENES FROM GREENSTONE FLOW

Kearsarge Flow

The chemical analyses (Table 7 and Figure 18) of 13 samples from the Kearsarge Flow add substantially to prior studies of the Portage Lake Lava Series. These samples were chosen to correlate this study with previous chemical studies of the Keweenawan lava flows. Twelve samples were taken at three foot intervals from the Star 10 diamond drill hole in Keweenaw County. This hole penetrates the total 32'9" thickness of the flow in this location. One additional sample was taken at a depth of 12½ feet for analysis since megascopic study indicated the possibility of unique lithology.

Although the flow is only 33 feet thick in this location, trends remarkably similar to those found by Broderick (1935) in the Kearsarge Flow are revealed by these chemical analyses. The upper half of the flow has the highest percentages of SiO_2, TiO_2, Na_2O, K_2O, and MnO and the lowest values of Al_2O_3, CaO, and MgO. Since iron was analyzed as FeO, petrographic study was combined with the analyses to indicate high Fe_2O_3 and low FeO in the top portion. These tendencies are maximized in sample 6 taken 12½ feet below the top where several dark brown bands 1/2" to 3/4" thick occur. Analyses of this sample of rock taken from such a band indicate a very high amount of SiO_2 and low percentages of CaO, MgO, FeO, and Al_2O_3. Thin section study indicates that this rock is coarser than the surrounding rock, and quartz and albite are present as expected. These bands obviously represent doleritic tendencies despite the fact that the flow is very thin at this point.

The amygdaloidal zone has the expected high percentage of Fe_2O_3


THICKNESS IN FEET
0
5
10
15
20
25
30
35
-20% -10% AVG. SiO2 10% 20% 30%
-30% -20% -10% AVG. CaO 10% 20% 30% 40%
-20% -10% AVG. MgO 10%
-20%

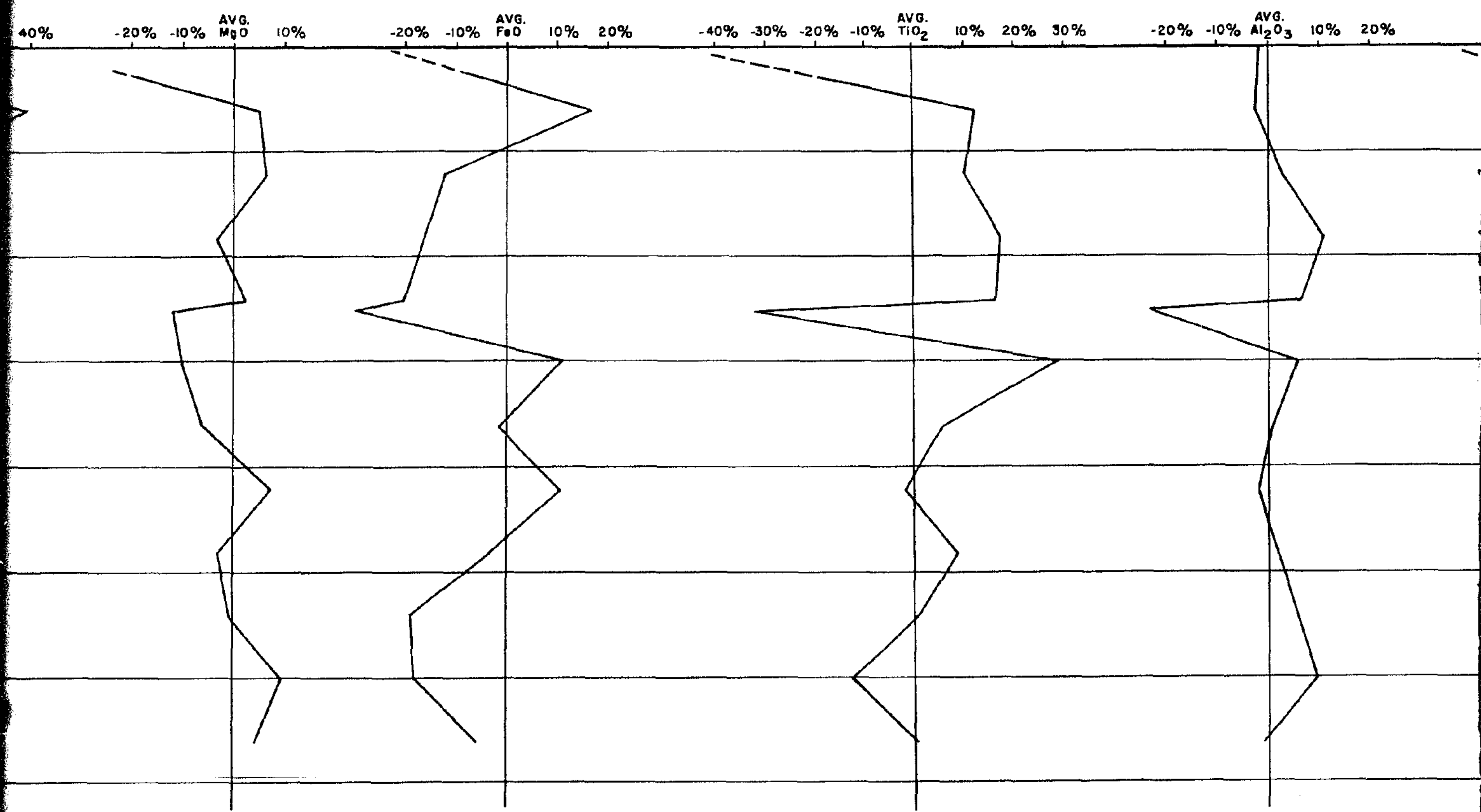
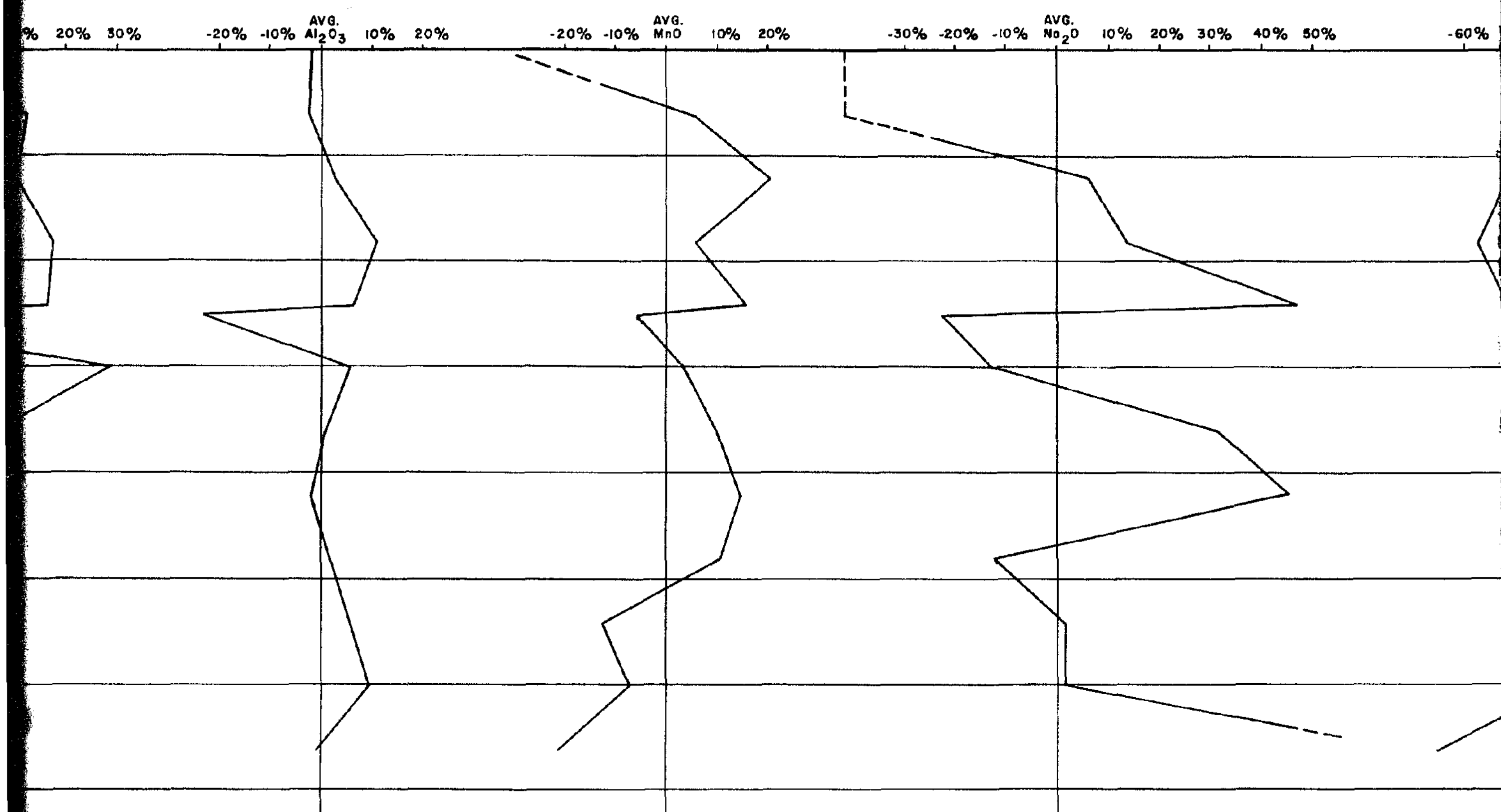


FIGURE 18
CHEMICAL COMPOSITION OF KEARSARGE FLOW
DIAMOND DRILL HOLE STAR 10



E 18
OF KEARSARGE FLOW
OLE STAR 10

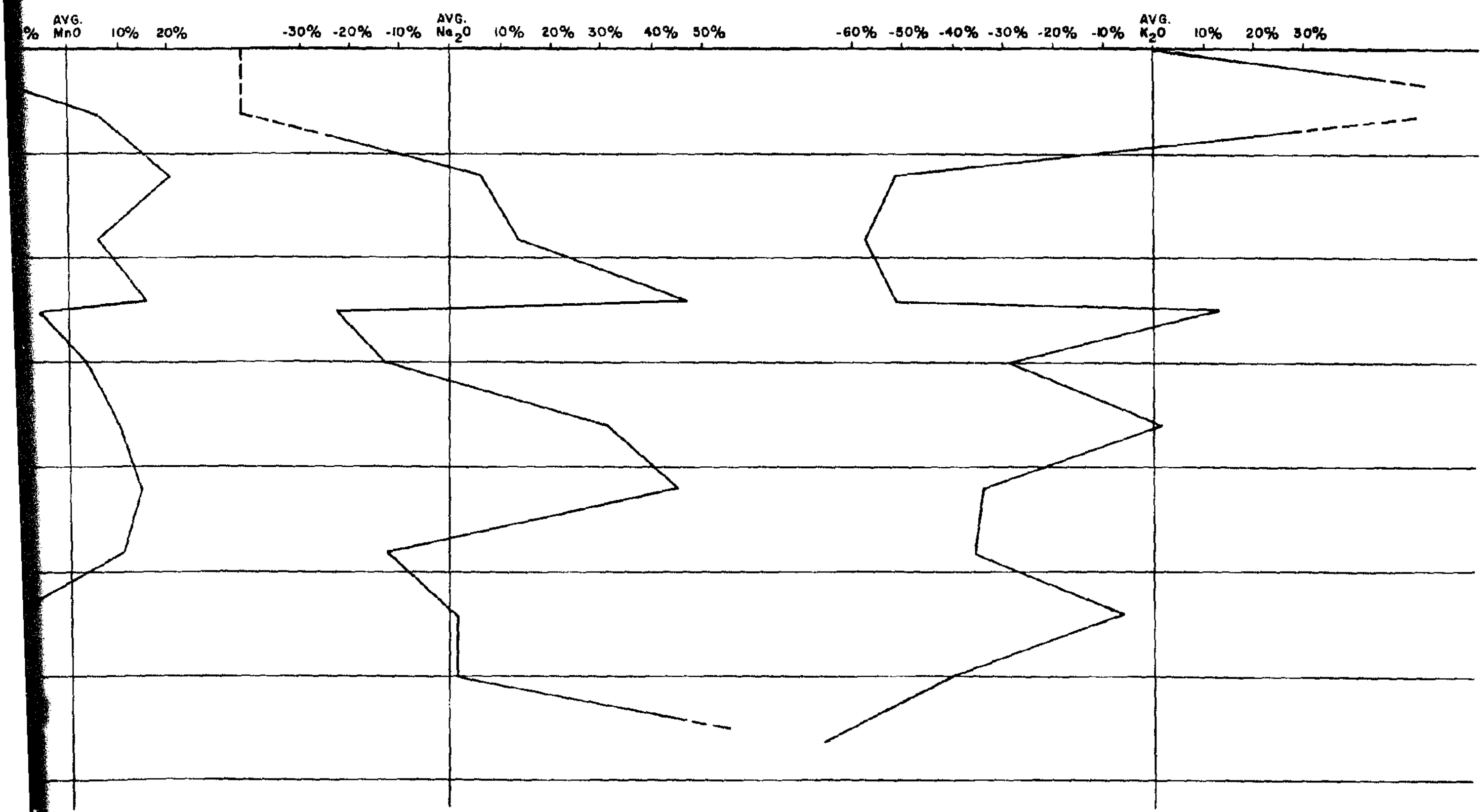

%
AVG. MnO
10%
20%
-30%
-20%
-10%
AVG. Na_2O
10%
20%
30%
40%
50%
-60%
-50%
-40%
-30%
-20%
-10%
AVG. K_2O
10%
20%
30%

Table 7. Chemical Composition of the Kearsarge Lava Flow, Diamond Drill Hole Star 10.

Sample	Depth	SiO_2	CaO	MgO	FeO	TiO_2	Al_2O_3	Na_2O	K_2O	MnO
1	0	34.43	27.90	2.66	5.17	1.14	14.96	0.44	0.86	0.107
2	3	37.81	9.61	9.23	15.22	2.61	14.92	0.38	4.05	0.196
3	6	46.99	7.95	9.40	11.50	2.56	15.59	3.26	0.42	0.223
4	9	48.00	6.72	8.52	10.94	2.73	16.89	3.49	0.37	0.195
5	12	47.36	5.65	9.03	10.43	2.70	16.26	4.51	0.42	0.214
6	12.5	59.82	2.22	7.81	8.93	1.58	11.74	2.36	0.97	0.175
7	15	44.38	8.43	7.90	14.44	3.01	14.44	2.68	0.61	0.192
8	18	45.73	6.91	8.28	12.84	2.46	15.09	4.02	0.87	0.203
9	21	45.89	6.33	9.48	14.41	2.30	14.94	4.44	0.57	0.211
10	24	45.87	8.46	8.53	12.63	2.53	15.43	2.68	0.47	0.205
11	27	48.09	6.95	8.80	10.58	2.34	16.02	3.11	0.81	0.161
12	30	46.38	8.50	9.63	10.71	2.04	16.68	3.11	0.51	0.172
13	32.7	47.59	5.00	9.20	12.39	2.34	15.16	5.35	0.29	0.145

and the basal chill zone has a higher amount of FeO, SiO_2, K_2O, and TiO_2 than the rock immediately above. A similar tendency was found by Cornwall (1951a) in the Greenstone Flow. Sample number one produced somewhat anomalous results due to the large amount of calcite deposited in vesicles in the flow top. Sample thirteen, at the bottom, had an excess of Na_2O evidently due to alteration. The plagioclase in this sample was oligoclase (An_{12}).

Calculation of the FeO/MgO ratio indicates an increase from the bottom to the center of the flow. Below the amygdaloidal zone, which had a high FeO/MgO ratio due to iron concentration, the ratio was relatively low and decreased downward until below the zone showing doleritic tendencies. Cornwall (1951a) found a similar trend for the FeO/MgO ratio in the Greenstone Flow.

These analyses found the same distribution of oxides through the flow as was found by Broderick (1935). Table 8 serves to compare the work of Broderick (1935) with the present study. Differences between the two sets of samples are: (1) thickness of the flow where studied by Broderick was 164 feet and (2) the pegmatitic layer in the part of the flow in this study is very distinct as compared to the vague pegmatitic tendency found elsewhere by Broderick (1935).

Table 8. Comparison of Chemical Analysis of Two Drill Holes in the Kearsarge Lava Flow.

Oxide	Broderick (1935)		Present Study	
	Ophite	Dolerite	Ophite	Dolerite
SiO_2	48.04	48.78	45.87	59.82
Al_2O_3	16.88	14.51	15.43	11.74
MgO	7.12	6.11	8.53	7.81
CaO	9.83	6.35	8.46	2.22
Na_2O	2.39	4.37	2.68	4.51
K_2O	0.46	0.82	0.47	0.97

PETROLOGY

The present study was conducted only on the Scales Creek Flow. Petrographic thin sections were prepared of samples chosen by megascopic examination of the core. The following composite description is based on petrographic analysis of 188 samples and is considered valid because of the lateral homogeneity of the flow.

Petrographic Description

The main minerals in the Scales Creek Flow are labradorite laths and anhedral, ophitic augite grains with minor amounts of pigeonite and subhedral, altered olivine. Accessory minerals include magnetite, hematite, and ilmenite. Plagioclase changes from labradorite in the main body of the flow to albite-oligoclase near the top and bottom.

The amygdaloidal flow tops have typical red coloration in the hand specimen due to the presence of hematite. Minerals forming the groundmass of the amygdaloidal tops are randomly distributed, altered plagioclase microlites, often in radiating groups, surrounded by chlorite and hematite that obscures all other minerals (Photo 3). Glomeroporphyritic groups of plagioclase phenocrysts show alteration to chlorite, calcite, paragonite, and epidote.

Amygdules of the flow top have been filled with epidote, quartz, prehnite, calcite, chlorite, and various zeolite minerals. Most vesicles contain more than one mineral, often having rims of epidote or hematite and central fillings of quartz or calcite (Photo 4).

Veins of quartz or calcite often cut the amygdaloidal zone.

Photo 3. Flow Top Showing Plagioclase in Matrix of Hematite. Amygdule is Filled with Quartz and Epidote. Crossed Nicols, X53, Sample LS30-1.

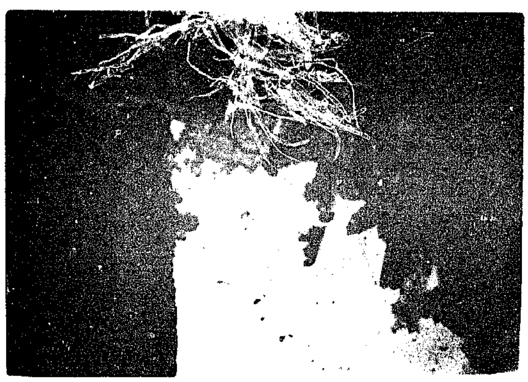


Photo 4. Portion of an Amygdule Showing Hematite and Epidote Rims with Central Quartz Filling. Crossed Nicols, X53, Sample SL5-1.

The upper chill zone of the flow is a microcrystalline, amygdaloidal rock with a diabasic texture. This grades downward through a zone of subophitic basalt with interstitial pyroxene into an ophitic texture with the plagioclase laths poikilitically included in the pyroxene (Photo 5). The ophitic texture becomes coarser with

Photo 5. Plagioclase Poikilitically Included in Pyroxene. Crossed Nicols, X133, Sample SL5-36.

depth in the flow until approximately the center, below which the grain size tends to decrease. Evidence of crystal settling is found in large pyroxene and olivine grains that occur above the basal chill zone (Photo 6).

In the central ophitic portion of the flow the plagioclase microlites often show alignment around larger mineral grains. These larger minerals, such as altered olivine and plagioclase laths appear to have been pushed aside to form channels through which microlite swarms moved (Photo 7). Other microlites appear in a swirled arrangement in the matrix giving the impression that the magma crystallized under mobile and somewhat turbulent conditions (Photo 8). This is also noted in the pyroxenes, may of which contain poikilitically included, semi-aligned feldspar microlites.

Pyroxenes of the central flow portion are not single crystals but

Photo 6. Large Plagioclase and Pyroxene Above the Basal Chill Zone. Crossed Nicols, X80, Sample SL5-46.

Photo 7. Microlite Swarm Around Altered Pyroxene and Plagioclase. Crossed Nicols, X133, Sample G7S-16.

groups of randomly oriented small equant crystals set in a matrix of chlorite, plagioclase microlites, and magnetite grains. Two pyroxenes, augite and pigeonite, occur mutually, although augite is the most abundant as the pigeonite occurs only as trace amounts. No visible exsolution lamellae are present in the pyroxenes. This, along with the lack of hypersthene, is to be expected from the studies

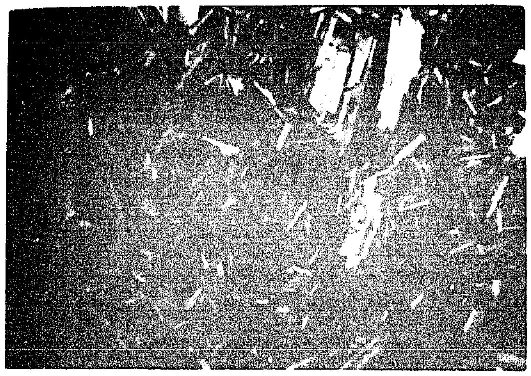


Photo 8. Microlites Showing Swirled Arrangement.
Crossed Nicols, X80, Sample NK3-18.

of Hess (1941) although Cornwall (1951a) did find a small amount of hypersthene in some thick flows. Distinction between augite and pigeonite, which was difficult in cases because the pigeonite occurs in such small grains, was made mainly on the basis of 2V angles estimated from optic axis figures obtained with a petrographic microscope. The 2V for pigeonite is 15^{o} and for augite is 42^{o}. Index tests were not made due to difficulty in working with the fragments and so no estimates of molecular composition are available.

The magnetite occurs as blebs in the matrix between plagioclase laths. Altered olivine is also found in the matrix and sometimes is included in the pyroxene granules. Many large plagioclase laths occur in glomeroporphyritic masses in the matrix. These laths are often fractured across their breadth and incipient alteration to chlorite has taken place along these fractures.

Very coarse-grained doleritic or pegmatitic concentrations of euhedral laths of oligoclase-andesine and augite (ferroaugite?) occur near the top of the flow and possibly near the bottom (Photo 9).

Photo 9. Doleritic Zone Showing Large Altered Plagioclase Laths and Quartz. Crossed Nicols, X80, Sample NK3-9.

These zones are indicated on Figures 7 through 14. The upper doleritic zone is better developed than the lower zone although it can be distinguished by both petrographic study and chemical analysis (Photo 10). Pegmatitic zones have been recognized for many years in the upper portions of Keweenawan lava flows but have not been reported before for the lower portions of such flows.

Observation indicates that the thickness and the coarseness of the upper dolerite is proportional to the lava flow thickness. Interstitial to the large laths of plagioclase in these pegmatitic zones are smaller grains of dendritic magnetite, hematite, ilmenite, and quartz.

The upper doleritic zone is highly altered. Plagioclase has changed to epidote, paragonite, carbonate, pumpellyite, and chlorite. Augite has altered to chlorite and secondary hornblende (Photo 11).

Augite and labradorite are slightly altered. The olivine has, in all cases, been destroyed by secondary alteration. The alteration

Photo 10. Large Altered Plagioclase Laths and Quartz in the Bottom Doleritic Zone. Crossed Nicols, X80, Sample NK3-54.

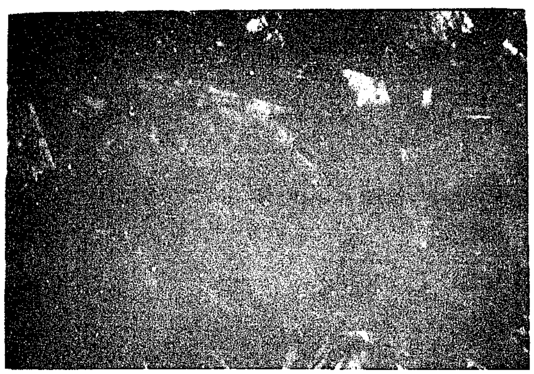


Photo 11. Pyroxene Altered to Secondary Hornblende. Crossed Nicols, X200, Sample NK3-24.

products are chlorite, serpentine, magnetite, hematite, iddingsite, and bowlingite. In many instances, it is felt by the author that the alteration products of the olivine occur as a fine-grained intermixture lacking definite optical properties. Bowlingite, a magnesium-rich clay mineral, is characterized by green color, strong pleochroism, third order interference colors, and lamellar structure with extinction

Statistically, the results seem satisfactory. With the exception of the motor vehicles and equipment employment equation, the sample data fit the theoretical relationships very well. Besides the relatively low value of R^2 for this equation, the coefficients of both the capital stock and the dummy variable for improved quality control were insignificant. Furthermore, the standard error of the OLS fit is quite high, over 10 percent of the 1968 values. While several factors could possibly explain these problems, a likely candidate is the dependent variable itself. Employment was chosen as a proxy for the more meaningful man-hours variable in keeping with the theoretical structure of the general model. Given the empirical results, a slight modification of the original hypothesis may be well-advised. Alternatively, the results would probably be improved by redefining employment in the industry to include the nearly 250 thousand workers who are classified in Standard Industrial Codes other than 371.

Two additional equations posed minor problems. The sign on U.S. automobile production in the payroll equation for transportation, communications, and public utilities was wrong, since intuitively one would expect this variable to be positively related to payrolls. The same was true for the sign of the wage rate variable in the equation for payrolls in mining. However, in this case the coefficient was not significant.

Forecasting Results

The primary purpose for constructing an econometric model of Michigan was to provide a mechanism for forecasting personal income. As a measure of how well the model performs in this aspect, the forecasting results are presented in Table 4. Although not entirely satisfactory, the results were encouraging and provide insights for future improvements.

As is usually the case, the results for some equations were better than others. Fortunately, however, the results for those components included in taxable income were quite good with the exception of nonfarm proprietor's income. The forecasts for the wage and salary components were especially encouraging since this portion of personal income comprises the withholding base for the Michigan personal income tax.

In terms of the forecasting errors, the model did very well. The percentage errors for the six quarter forecasting period were respectively 1.51, 1.08, 0.76, 2.17, 2.08, and 3.07 percent. The overall error for the period was 1.81 percent. The model predicted not only all the correct signs of the actual changes but, in addition, accurately predicted the signs of the rates of year-ago quarter changes. The actual year-ago quarter moves were 9.9, 8.3, 8.5, 8.1, 5.2, and 8.7 percent. The forecasted changes were respectively 8.2, 7.1, 7.6, 5.7, 3.0, and 5.3 percent.

Table 4. Forecasting results of the model.

	WS^{MIN} Forecasted	WS^{MIN} Actual	WS^{CC} Forecasted	WS^{CC} Actual	WS^{371} Forecasted	WS^{371} Actual
1969 1	25.3	23.4	233.1	272.3	1,103.8	1,173.2
1969 2	26.7	26.8	319.8	332.0	1,043.9	1,064.7
1969 3	27.9	29.0	353.5	398.4	1,041.0	1,040.4
1969 4	29.1	28.8	359.4	378.3	1,080.2	1,108.2
1970 1	25.8	23.8	354.1	279.3	893.2	1,019.9
1970 2	26.1	27.8	355.7	332.7	1,005.2	1,018.0

	WS^{OD} Forecasted	WS^{OD} Actual	WS^{FAK} Forecasted	WS^{FAK} Actual	WS^{TEX} Forecasted	WS^{TEX} Actual
1969 1	1,319.3	1,266.8	96.1	98.6	47.8	50.2
1969 2	1,298.8	1,307.5	100.3	102.7	47.9	47.2
1969 3	1,291.9	1,271,4	107.3	110.2	45.5	53.9
1969 4	1,338.0	1,388.8	105.5	112.8	50.1	50.1
1970 1	1,315.1	1,254.5	98.1	100.9	43.7	41.1
1970 2	1,259.3	1,288.0	101.2	109.0	45.5	43.0

	WS^{OND} Forecasted	WS^{OND} Actual	WS^{MFG} Forecasted	WS^{MFG} Actual	WS^{TCU} Forecasted	WS^{TCU} Actual
1969 1	301.6	305.6	2,868.6	2,894.4	311.7	317.2
1969 2	306.3	315.4	2,797.2	2,837.5	318.2	328.2
1969 3	315.0	312.2	2,800.7	2,788.1	329.1	349.0
1969 4	317.4	349.1	2,891.2	3,009.0	347.9	360.6
1970 1	327.7	315.9	2,687.8	2,732.3	314.4	330.5
1970 2	326.6	313.9	2,725.1	2,785.4	329.4	352.2

Table 4. Continued.

	WS^{WT} Forecasted	WS^{WT} Actual	WS^{RT} Forecasted	WS^{RT} Actual	WS^{SER} Forecasted	WS^{SER} Actual
1969 1	311.6	313.0	527.8	524.5	565.1	562.7
1969 2	314.1	310.5	542.9	549.5	583.3	609.1
1969 3	328.4	324.0	572.4	564.0	612.4	647.5
1969 4	345.8	352.0	596.9	624.5	655.6	698.7
1970 1	341.0	350.6	584.3	561.0	641.2	658.3
1970 2	349.5	335.8	583.9	586.8	661.6	691.9

	MWS Forecasted	MWS Actual	OLI Forecasted	OLI Actual	PROPNF Forecasted	PROPNF Actual
1969 1	5,927.5	5,991.8	393.0	406.2	547.5	604.6
1969 2	6,006.9	6,098.3	404.2	406.2	582.2	561.0
1969 3	6,039.8	6,115.4	404.0	406.3	582.1	538.0
1969 4	6,430.5	6,656.5	405.2	406.3	653.4	595.4
1970 1	6,123.0	6,127.9	497.7	505.0	549.5	575.2
1970 2	6,282.6	6,363.6	501.3	505.0	609.2	664.7

	PROPY Forecasted	PROPY Actual	TRANS Forecasted	TRANS Actual	EECFSS Forecasted	EECFSS Actual
1969 1	1,112.2	1,087.1	605.5	619.3	250.2	265.5
1969 2	1,133.0	1,138.5	609.9	622.2	265.8	265.2
1969 3	1,142.6	1,153.0	618.7	640.2	222.6	222.7
1969 4	1,187.9	1,217.4	619.0	640.3	131.4	158.0
1970 1	1,141.1	1,221.3	651.3	723.3	255.7	258.4
1970 2	1,193.7	1,228.7	697.3	815.4	268.1	260.0

Table 4. Continued.

	CFSI Forecasted	CFSI Actual	MNWS Forecasted	MNWS Actual	MPI Forecasted	MPI Actual
1969 1	337.6	333.3	2,392.3	2,455.6	8.317.8	8,447.4
1969 2	337.1	334.5	2,463.9	2,465.1	8,470.8	8,563.4
1969 3	287.4	287.1	2,531.8	2,522.2	8,571.6	8,637.6
1969 4	209.6	226.1	2,727.7	2,705.1	9,158.2	9,361.6
1970 1	333.0	338.0	2,577.8	2,758.0	8,700.8	8,885.9
1970 2	334.6	342.1	2,738.1	2,942.9	9,020.7	9,306.5

	EMP^{371} Forecasted	EMP^{371} Actual
1969 1	397.9	401.6
1969 2	387.0	393.9
1969 3	369.7	394.4
1969 4	406.7	403.2
1970 1	396.4	369.6
1970 2	382.0	366.8

Concluding Summary

With regard to the primary purpose of the model, the results seem very satisfactory as attested to by the high degree of accuracy of the forecasts for personal income and, in particular, the wage and salary component. The average forecasting error for the payroll component was only 1.5 percent, or $90.5 million. Given the personal income tax rate of 2.6 percent, this would imply an average error of $2.4 million for withholding. For the 1969-70 fiscal year, this would indicate an error of $9.6 million, or 2.0 percent of the actual withholding collections of $486.2 million.[22] From a budgeting viewpoint an error of this magnitude is well within manageable bounds, especially since short-run revisions are possible based upon the current rate of collections. Underscoring this point is the fact that the error of the official forecasts for the withholding component of the personal income tax for the 1969-70 fiscal year was $12.9 million, or 2.7 percent of actual collections.[23]

A secondary goal of the study was to cast some light on the role that the automobile industry plays in shaping the Michigan economy. To this end, U.S. automobile

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[22] Detail for this revenue source was provided by A. Thomas Clay of the Executive Office, Bureau of Programs and Budget.

[23] *Ibid.*

production was specifically included among the exogenous variables of the model. Although the following analysis is, at best, a cursory one, it does provide some indication of the impact of the industry on economic activity in Michigan.

Table 5. U.S. passenger car production.

1956	5,806,756
1957	6,120,029
1958	4,247,371
1959	5,599,468
1960	6,703,108
1961	5,522,019
1962	6,943,334
1963	7,644,337
1964	7,745,492
1965	9,335,227
1966	8,604,712
1967	7,412,659
1968	8,848,620
1969	8,224,392
1970	6,549,058

Source: 1971 Economic Report of the Governor, Appendix, Table B-29, p. 127.

To begin, one may write the reduced form ordinary least squares equation for total wages and salary disbursements as

$$MWS = 360.924 - 208.583q_1 - 161.655q_2 - 45.251q_3 + 0.171\ USAP + Z$$

where Z represents the remaining predetermined variables in the reduced-form equation. This equation would tend to indicate that the marginal contribution of a single automobile assembly to total Michigan payrolls is only $171. Given the average factory price of around $2,000 over the sample period, the coefficient would intuitively seem to be much too small. However, several factors must be taken into account before drawing such a conclusion.

First, Michigan only accounts for approximately one-third of final assemblies. Given this fact, the marginal contribution of a Michigan assembly would be $516 per car. Furthermore, the U.S. automobile production relates only to assemblies, and, as a consequence, does not reflect the manufacture of parts or equipment. The reduced-form equation, therefore, reflects only the marginal cost of an automobile. It implicitly assumes, therefore, that the cost of the parts, overhead, etc., are zero and that the marginal unit requires no additional employment, capital, or other factors of production.

As shown in Table 5, U.S. automobile production has fluctuated widely during the sample period, from a low of 4,247 thousand units in 1958 to 9,335 thousand units in 1965. While data relating to industry cost curves is unavailable, it would seem likely that they would exhibit relatively constant average and marginal cost over a broad range. Hence, during periods of comparatively low production, a figure of $516 would seem reasonable as a measure of the marginal contribution to total state payrolls.

However, during periods of high production, this figure would indeed be too small since it would fail to capture such factors as overtime (at premium pay rates), the additional cost of producing the parts, and added employment.

CHAPTER IV

CONCLUSION

The purpose for constructing the model presented in the previous chapter was twofold. The broad objective was to provide an analytical description of the Michigan economy. It was hoped that the model would contribute towards a better understanding of the workings of the economy and, in particular, the interplay between broad aggregate sectors. On a more pragmatic level, the model was intended to serve as a mechanism for forecasting personal income, also by broad categories. As previously indicated, the model was relatively successful on both counts. In addition, it was hoped to improve both the methodology and estimation techniques previously employed in the construction of state econometric models. It is in this area that the model presented in Chapter III perhaps makes its greatest contribution.

To date, the previous state econometric models, with the exception of the Ohio model, have been lacking from one of several vantage points: (1) no well-defined theoretical basis; (2) use of inefficient and, in some instances, inconsistent estimation techniques; and

(3) a general disregard for any practical application. In the process of solving these shortcomings, it was necessary to create a new data series--namely, quarterly personal income by broad sectors (unadjusted for seasonal variation). The quarterly personal income data series for Michigan contained in Appendix D represents the first time such a series has been constructed. The choice of the quarterly format for the model set out in Chapter III, and hence the need to build the data series, was based upon two considerations--the increased utility the quarterly approach offers for analysis and forecasting purposes and, simultaneously, the larger number of observations it affords.

In an economy such as Michigan's, which relies heavily upon both consumers' and producers' durable goods manufacturing industries, it is essential to be able to quickly detect major economic fluctuations. The limitations imposed by an annual format severely limits this capability. A quarterly format reduces these limitations since it has the advantage of being able to utilize current data. As a consequence, it allows for a more accurate description of economic activity and, ceteris paribus, more accurate estimates and forecasts of tax revenues.

Theoretical Background

The formulation of the model was explicitly designed so as to maintain a solid link with economic theory. The advantages this approach affords are obvious. First, it allows the user the ability to compare and criticize the model from more than the "proof of the pudding" argument, i.e., how well it forecasts. Secondly, a well defined model yields more information than a loosely designed one since it allows a larger number of inferences regarding parameter values, possible constraints, etc.

The choice of the predetermined variables in the model was influenced by two requirements: the ease with which they themselves may be forecasted and, when possible, their inclusion in one of the larger national econometric models. This approach greatly simplifies the forecasting process and, at the same time, allows one to determine the sensitivity of the Michigan forecast for the range of values generated by the national models.

Estimation Technique

The model presented in Chapter III is the first state model to employ a systems method of estimation. The most sophisticated technique utilized previously was two-stage least squares in both the Massachusetts and Ohio models, whereas the model set out in this paper has been estimated by the more efficient method of three-stage least squares.

Policy Implication

And finally, the development and the presentation of the model itself was carried out with the explicit aim of making the study useful to policy makers. Some of the results generated by the model indicate its utility for planning and budgeting purposes.

As mentioned in Chapter I, the most common form of forecasting methodology employed in state government is trend analysis, i.e., the normal growth pattern. The problem with this method is that it fails to account for both major swings in the economy and the pattern of change throughout the forecasting period. Table 6 presents the personal income forecasts generated by the model in Chapter III, the "naive" forecast based upon a five percent normal growth, and in addition, the forecasting results of the Suits model.

As Table 6 indicates, the quarterly model yielded far more accurate forecasts than either the "naive" forecast or that generated by the Suits model. In terms of Michigan's major revenue sources, the individual income and sales taxes, the 1969 forecast generated by the quarterly model would have implied a yield of $726 million for the sales tax and $464 million for the personal income tax withholding. The actual revenue yields from these two tax sources were $729 million and $475 million, or a combined error of only 1.2 percent. In comparison, the Suits

Table 6. Comparison of annual personal income forecasts, 1969.

	Actual	Naive	Percent Error	Suits Model	Percent Error	Quarterly Model	Percent Error
Personal Income	35,010	33,833	3.36	33,700	3.74	34,520	1.40
Wage and Salary Disbursements	24,862	23,810	4.23	23,660	4.83	24,410	1.82
Other Sources of Personal Income	10,148	10,023	12.3	10,040	1.06	10,110	0.37

model indicated sales tax receipts of $741 million, or an error of 1.65 percent compared to the quarterly model's 0.42 percent.[24]

Another area where the model may prove useful is its ability to help predict the impact of major strikes in the automobile industry on personal income and the yield of the personal income tax. The experience of 1970 provides such an example.

The 2 1/2 month United Automobile Workers strike at the General Motors Corporation caused an estimated production loss of 1.2 million units. In terms of the model, this loss would imply a $205 million reduction in personal income and a $5.3 million loss in withholding under the Michigan personal income tax. Actual losses due to the strike are estimated at $8.9 million.[25]

Areas for Future Improvements

While the results of the model presented in Chapter III are encouraging, they by no means represent the final product. The most obvious areas for expansion and improvement would be the inclusion of the consumption and tax subsets which are currently being developed by the

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[24] Revenue implication for the quarterly model forecast were prepared by the Executive Office, Bureau of Programs and Budget.

[25] Ibid.

State of Michigan. In terms of individual equations, those for payrolls and employment in motor vehicles and equipment, property income, and contract construction present areas where concrete improvements should be forthcoming. As with all such models the first results always seem to spawn constructive discussion and analysis. It is hoped that this paper will likewise provide an impetus for additional research of the Michigan economy.

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APPENDIX A

APPENDIX A

DESCRIPTION OF PREVIOUS STATE ECONOMETRIC MODELS: CHAPTER II

California, (Burton and Dyckman) - Phase II Model

1. Type of data	Quarterly data. All personal income (wage and non-wage) and miscellaneous (corporate income, retail sales, etc.) variables are in current dollars.
2. Period covered	For most of the variables: First quarter 1950 through the fourth quarter, 1962.
3. Method of Estimation	OLS
4. Number of stochastic equations	Personal Income: a. Wage and salary: a maximum possibility of three wage and salary disbursement equations per industry (59 industries)--some industries are represented by only one or two equations, however. Total number = 108 b. Non-wage income: -Other Labor income--1 equation -Non-Farm Proprietor's income--1 equation -Farm Proprietor's income--1 equation -Property income--1 equation -Transfer Payments--1 equation -(minus) Personal Contributions for Social Insurance--1 equation Total number = 6 equations Total number of Personal Income Equations = 114

	Miscellaneous: a. Major self-assessed taxable sales--9 equations b. Employment translators--53 equations c. Net Income of Corporation--1 equation d. Assessed motor vehicle gasoline gallonage--1 equation Total number of miscellaneous equations = 65 Total number of stochastic equations = 179
5. Definitional equations	-Personal income identity--1 equation -Wage and Salary identities--36 equations -Those identities listed on the bottom of p. 59--14 equations -Employment equations ($M_{i_t}=W_{i_t}/E_{i_t}$)--53 equations Total number of definitional equations = 104
6. Total number of equations	179 stochastic + 104 definitional equations = 283
7. Main institutional, technical and behavioral equations	Personal income Employment Miscellaneous (they are listed under (8)).
8. Endogenous variables	Wage and salary disbursements in 59 California industries (each industry is broken down into final inter-industry and export demand). Non-wage component of personal income (other labor income, farm proprietors' income, non-farm proprietor's income, property income and transfer payments). Personal Contributions for Social Insurance. Employment in 53 California industry groups. Miscellaneous (major self-assessed taxable sales, corporation income, gasoline gallonage, and unemployment).

9. Main exogenous variables	The 20 national variables listed in Table 6 (8) on p. 20
10. Dynamic features	Use of autogressive terms and rate of change variables. Lags up to three quarters in non-autogressive variables.
11. Other noteworthy features	Extensive use of first differences to guard against multi-collinearity. The model consists of three successive parts. The temporal ordering is as follows: the first part is personal income; the second, employment; and the third, miscellaneous.

Massachusetts (Bell)

1. Type of data	Annual data. All variables are in constant 1947 dollars.	
2. Period covered	1947-1962.	
3. Method of estimation	OLS, RFLS, 2SLS (RFLS is reduced-form least squares).	
4. Number of stocastic equations	8	
5. Definitional equations	6	
6. Total number of equations	14	
7. Main institutional, technical and behavioral equations	Export	Production
	Local consumption	Expected labor supply
	Manufacturing investment	Migration
	Non-manufacturing investment	Wage Bargain
8. Endogenous variables	Export income	Investment in non-Manufacturing sector
	Local service income	
	Total received income	Employment
	Total produced income	Labor Supply

	Total capital stock	Expected labor supply
	Manufacturing capital stock	Population
	Non-manufacturing capital stock	Expected population
	Investment in manufacturing sector	Annual wage per employee
		Migration
		Unemployment
9. Exogenous variables	Gross national product	Capital stock in manufacturing
	Birth rate minus the death rate	Capital stock in non-manufacturing
	Prospective unemployment	Time

10. Dynamic features — One year lags.

All equations are linear except the production and wage bargain equations. The manufacturing investment equation has been linearized by taking a logarithmic transformation of the original specification.

11. Other noteworthy features — Links national and regional variables.

Michigan (Research Seminar in Quantitative Economics)

1. Type of data — Annual data in constant 1954 dollars.

2. Period covered — 1949-1964.

3. Method of estimation — OLS

4. Number of stochastic equations	Gross state product and components	8
	Retail sales	9
	Employment, unemployment, labor force	2
	Personal income	8
	Eight industries (3 equations for each	24
	Services	4
	Construction	3
Number of non-stochastic equations	Employment, unemployment, labor force	6
	Total	64

5. Number of definitional equations	Employment, unemployment, labor force	14
6. Total number of equations		78

7. Main institutional technical and behavioral equations

Gross state product	Personal income
Retail Sales	Increase in value added
Employment	Value added per man hour
Labor force	Increase in annual hours per worker

8. Main endogenous variables

Total GSP (broken down into GSP by manufacturing, trade, mining, construction, agriculture, government and other).

Retail Sales (broken down into automotive dealers; general stores; furniture stores; apparel stores; food stores, eating and drinking places; building, lumber, and hardware; and others).

Employment (broken down into manufacturing, non-manufacturing, self employment, government, and agriculture).

Michigan population, age 14 and over.

Net migration into Michigan.

Increase in Michigan labor force.

Change in Michigan unemployment.

Personal Income (broken down into seven major classifications).

Increase in value added, value added per man hour, and increase in annual hours per worker.

Various state taxes: motor vehicle, corporate vehicle, corporate franchise, other state local property and income taxes.

9. Main exogenous variables	Total U.S. expenditure for new and net used automobiles by all U.S. consumers. Total expenditure by all U.S. businesses for producers' durable equipment. Total privately produced U.S. gross national product other than automobiles and producers' durable equipment. U.S. increases in expenditures for gas and oil, transportation services, food and beverages, and construction other than housing. Michigan financial variables: demand and time deposits, savings and loan shares. New automobile registrations in Michigan.
10. Dynamic features	Use of autoregressive schemes.
11. Other noteworthy features	Incorporates Michigan's GSP and components in the specification of the model. Also the relationships among output, productivity and employment are stressed.

Ohio (L'Esperance, Nestel and Fromm)

1. Type of data	Annual data in physical units (e.g., gallons) or in constant 1958 dollars.
2. Period covered	1945-1965; all equations are fitted to subsets of that period.
3. Method of estimation	OLS, 2SLS.
4. Number of stochastic equations	16
5. Definitional equations	11

6.	Total number of equations	27
7.	Main institutional technical and behavioral equations	Retail sales (2 equations). Personal income and federal income tax. GSP of Ohio (7 components). Sales tax receipts. Bases of motor vehicle fuel and motor vehicle registration taxes.
8.	Main endogenous variable	Total GSP (and 7 components). Personal income, income taxes, and disposable personal income. Retail sales (2 components). Manufacturers' investment expenditure (2 components). Various state taxes and/or their bases; sales tax, motor vehicle fuel tax, motor vehicle registration tax.
9.	Exogenous variables	First difference of GNP in manufacturing; two interest rates, percentage rate or change of level of U.S. automobile installment credit; Ohio housing permits; lagged values of various endogenous variables, including components of GSP, GSP in state and local government; GSP in federal government; Military prime contract awards in Ohio; a total of 15.
10.	Dynamic features	Use of autoregressive terms in identities; use of first differences of endogenous variables; lags in investment equation. All equations are linear.
11.	Other noteworthy features	Some of the exogenous variables are government policy variables.

Source: An Econometric Model of Ohio, pp. 28-33.

An Econometric Model of Michigan

Endogenous Variables

GSP	Gross state product--estimated by the University of Michigan Research seminar in Quantitative Economics.
GSPMFG	Gross state product originating in manufacturing.
GSPWR	Gross state product originating in wholesale and retail trade.
GSPMIN	Gross state product originating in mining.
GSPCC	Gross state product originating in contract construction.
GSPAGR	Gross state product originating in agriculture.
GSPOTH	Gross state product originating in all other sectors
MRST	Total retail sales.
MRSAD	Retail sales by automotive dealers.
MRSGS	Retail sales by general stores.
MRSFUS	Retail sales by furniture stores.
MRSAS	Retail sales by apparel stores.
MRSFOS	Retail sales by food stores.
MRSEAD	Retail sales by eating and drinking establishments.
MRSBLH	Retail sales by building, lumber, and hardware stores.
MRSOTH	Retail sales by all other stores.
MPI	Personal income.
MPIWS	Total wages and salaries.
MPIWSMFG	Wages and salaries paid by manufacturing.
MPIWSWR	Wages and salaries paid by wholesale and retail trade.
MPIWSMIN	Wages and salaries paid by mining.
MPIWSCC	Wages and salaries paid by contract construction.
MPIWSTR	Wages and salaries paid by transportation.
MPIWSOI	Wages and salaries paid by all other industries.
MPIPROP	Property income.
MPIOLI	Other labor income.
MPINFPI	Non-farm proprietors income.
MPITR	Transfer payments.
MPIAGRI	Agricultural income.

Predetermined Variables

USAE	U.S. automobile expenditures.
USPDE	U.S. producers' durables expenditures.
USGNPOT	Other private non-imputed GNP (compiled by the Research Seminar in Quantitative Economics)

USNRCC	U.S. non residential construction.
GSP	Past peak Michigan GSP.
GSP-2	Michigan GSP two years ago.
GSPMFG-1	Last year's Michigan GSPMFG.
In general XYZ-1	Last year's XYZ.
USGAO	U.S. gas and oil expenditures.
USTSE	U.S. transportation service expenditures.
USFAB	U.S. food and beverage expenditures.
USGNPPVT	U.S. privately produced GNP.
GSPGOV	GSP originating in government.
MPIWSGOV	Wages and salaries paid by government.
MUEMP	Michigan unemployment (in thousands).

Equations (as published)

$$\Delta GSP = -0.626 + 0.228\ \Delta USAE + 0.136\ \Delta USPDE + 0.080\ \Delta USGNPOT$$
$$\Delta GSPMFG = -0.734 + 0.220\ \Delta USAE + 0.044\ \Delta USPDE + 0.066\ \Delta USGNPOT$$
$$\Delta GSPWR = -0.023 + 0.033\ \Delta USAE + 0.022\ \Delta USPDE + 0.006\ \Delta USGNPOT$$
$$\Delta GSPMIN = -0.002 + 0.018\ \Delta USNRCC$$
$$\Delta GSPCC = 0.002 + 0.0304\ (GSPMFG - GSP) + 0.020\ (GSP - GSP - 2)$$
$$\Delta GSPAGR = \text{Trend value}$$
$$\Delta GSPOTH = 0.100 + 0.002\ \Delta USAE + 0.037\ \Delta USPDE + 0.006\ \Delta USGNPOT$$

$$\Delta MRST = -0.1960 + 0.187\ \Delta USAE + 0.020\ \Delta USGNPOT$$
$$\Delta MRSAD = -0.0677 + 0.111\ \Delta USAE + 0.004\ \Delta USGNPOT$$
$$\Delta MRSGS = -0.0195 + 0.014\ \Delta USAE + 0.012\ \Delta USPDE$$
$$\Delta MRSFUS = 0.0011 + 0.010\ \Delta USAE + 0.010\ \Delta USPDE$$
$$\Delta MRSAS = 0.0056 + 0.007\ \Delta USAE$$
$$\Delta MRSFOS = 0.0493 + 0.023\ \Delta USAE$$
$$\Delta MRSEAD = -0.0033 + 0.006\ \Delta USAE + 0.001\ \Delta USGNPOT$$
$$\Delta MRSBLH = 0.0044 + 0.009\ \Delta USAE$$
$$\Delta MRSOTH = -0.0209 + 0.012\ \Delta USAE + 0.003\ \Delta USGNPOT$$

$$\Delta MPI = 0.4049 + 0.141\ \Delta USAE + 0.159\ \Delta USPDE$$
$$\Delta MPIWSMFG = 0.02722 + 0.160\ \Delta USAE + 0.066\ \Delta USPDE$$
$$\Delta MPIWSWR = 0.03711 + 0.009\ \Delta USAE + 0.027\ \Delta USPDE$$
$$\Delta MPIWSMIN = -0.00308 + 0.00096\ \Delta USGAO + 0.0078\ \Delta USNRCC$$
$$\Delta MPIWSCC = 0.00427 + 0.0361\ \Delta USNRCC$$
$$\Delta MPIWRSTR = -0.00226 + 0.0044\ \Delta USAE + 0.0058\ \Delta USPDE + 0.0313\ \Delta USTSE$$
$$\Delta MPIWSOI = 0.03341 + 0.0059\ \Delta USPDE + 0.0243\ \Delta USFAB$$
$$\Delta MPIWS = \overset{7}{(x)} \Sigma \Delta MPIWS_i{}^{*}$$

*The summation extends over the seven wage and salary categories listed, i.e., manufacturing, wholesale and retail trade, mining, contract construction, transportation, other industries, and government.

ΔMPIPROP = 0.0728 + 0.0145 ΔUSAE
ΔMPIOLI = 0.02409 + 0.052 ΔMPIWS
ΔMPINFPI = -0.08103 + 0.0021 ΔUSGNPPVT + 1.14 ΔMPIWSOI
ΔMPITR = 0.5758 + 0.869 ΔMUEMP**
ΔMPIAGRI = Trend value

Refitted Equations

ΔGSP = -0.500 + 0.222 ΔUSAE + 0.163 ΔUSPDE + 0.065 ΔUSGNPOT
(0.201) (0.052) (0.065) (0.016)

$\bar{R}^2$ = .931
D.W. = 1.227

ΔGSPMFG = -0.596 + 0.219 ΔUSAE + 0.076 ΔUSPDE - 0.050 ΔUSGNPOT
(0.171) (0.045) (0.055) (0.014)

$\bar{R}^2$ = .919
D.W. = 1.692

ΔGSPWR = -0.035 + 0.030 ΔUSAE + 0.020 ΔUSPDE + 0.006 ΔUSGNPOT
(0.037) (0.010) (0.012) (0.003)

$\bar{R}^2$ = .839
D.W. = 1.277

ΔGSPMIN = -0.002 + 0.017 ΔUSNRCC
(0.004) (0.005)

$\bar{R}^2$ = .461
D.W. + 2.098

ΔGSPOTH = 0.102 + 0.001 ΔUSAE + 0.037 ΔUSPDE - 0.005 ΔUSGNPOT
(0.037) (0.001) (0.012) (0.003)

$\bar{R}^2$ = .750
D.W. = 1.413

ΔMRST = 0.273 + 0.224 ΔUSAE + 0.008 ΔUSGNPOT
(0.130) (0.035) (0.008)

$\bar{R}^2$ = .812
D.W. = 1.547

**The Michigan unemployment variable while listed as exogenous here is an endogenous variable in the complete Michigan model. It is treated as being exogenous since the employment subset is not included.

$$\Delta MRSAD = \underset{(0.044)}{0.010} + \underset{(0.035)}{0.129}\ \Delta USAE - \underset{(0.003)}{0.003}\ \Delta USGNPOT$$

$\bar{R}^2$ = .930
D.W. = 1.917

$$\Delta MRSGS = \underset{(0.013)}{0.031} + \underset{(0.006)}{0.014}\ \Delta USAE + \underset{(0.006)}{0.007}\ \Delta USPDE$$

$\bar{R}^2$ = .492
D.W. = 1.829

$$\Delta MRSFUS = \underset{(0.009)}{0.0004} + \underset{(0.004)}{0.010}\ \Delta USAE + \underset{(0.004)}{0.005}\ \Delta USPDE$$

$\bar{R}^2$ = .503
D.W. = 0.786

$$\Delta MRSAS = \underset{(0.006)}{0.009} + \underset{(0.002)}{0.006}\ \Delta USAE$$

$\bar{R}^2$ = .368
D.W. = 1.343

$$\Delta MRSFOS = \underset{(0.016)}{0.079} + \underset{(0.006)}{0.009}\ \Delta USAE$$

$\bar{R}^2$ = .094
D.W. = 1.060

$$\Delta MRSEAD = \underset{(0.011)}{0.023} + \underset{(0.003)}{0.009}\ \Delta USAE + \underset{(0.001)}{0.001}\ \Delta USGNPOT$$

$\bar{R}^2$ = .402
D.W. = 2.168

$$\Delta MRSBLH^* = \underset{(0.015)}{0.002} + \underset{(0.006)}{0.009}\ \Delta USAE$$

$\bar{R}^2$ = .111
D.W. = 1.482

$$\Delta MRSOTH = \underset{(0.024)}{0.024} + \underset{(0.006)}{0.014}\ \Delta USAE + \underset{(0.002)}{0.00002}\ \Delta USGNPOT$$

$\bar{R}^2$ = .300
D.W. = 1.250

$$\Delta MPI = 0.399 + 0.142\ \Delta USAE + 0.146\ \Delta USPDE$$
$$(0.104)\quad (0.050)\qquad\qquad (0.059)$$

$\bar{R}^2 = .712$
D.W. = 2.386

$$\Delta MPINSMFG = 0.027 + 0.128\ \Delta USAE + 0.104\ \Delta USPDE$$
$$(0.078)\quad (0.037)\qquad\qquad (0.044)$$

$\bar{R}^2 = .749$
D.W. = 1.764

$$\Delta MPIWSWR = 0.036 + 0.009\ \Delta USAE + 0.026\ \Delta USPDE$$
$$(0.007)\quad (0.003)\qquad\qquad (0.004)$$

$\bar{R}^2 = .884$
D.W. = 1.368

$$\Delta MPIWSMIN = -0.007 + 0.012\ \Delta USGAO + 0.008\ \Delta USNRCC$$
$$(0.006)\quad (0.014)\qquad\qquad (0.003)$$

$\bar{R}^2 = .595$
D.W. = 2.131

$$\Delta MPIWSCC = 0.004 + 0.036\ \Delta USNRCC$$
$$(0.012)\quad (0.015)$$

$\bar{R}^2 = .281$
D.W. = 1.736

$$\Delta MPIWSTR = -0.002 + 0.004\ \Delta USAE + 0.006\ \Delta USPDE + 0.030\ \Delta USTSE$$
$$(0.004)\quad (0.001)\qquad\qquad (0.002)\qquad\qquad (0.016)$$

$\bar{R}^2 = .848$
D.W. = 1.016

$$\Delta MPIWSOI = 0.033 + 0.005\ \Delta USPDE + 0.025\ \Delta USFAB$$
$$(0.011)\quad (0.004)\qquad\qquad (0.008)$$

$\bar{R}^2 = .780$
D.W. = 2.207

$$\Delta MPIPROP = 0.072 + 0.014\ \Delta USAE$$
$$(0.017)\quad (0.006)$$

$\bar{R}^2 = .237$
D.W. = 2.028

$$\Delta MPIOLI = \underset{(0.013)}{0.024} + \underset{(0.017)}{0.052}\, \Delta MPIWS$$

$\bar{R}^2$ = .402
D.W. = 1.252

$$\Delta MPINFPI = \underset{(0.027)}{-0.096} + \underset{(0.001)}{0.002}\, \Delta USGNPOT + \underset{(0.369)}{1.323}\, \Delta MPIWSOI$$

$\bar{R}^2$ = .631
D.W. =

$$\Delta MPITR = \underset{(0.020)}{0.056} + \underset{(0.0002)}{0.001}\, \Delta MUEMP$$

$\bar{R}^2$ = .582
D.W. = 2.631

Econometric Model of Massachusetts

Edogenous Variables

X_t	Export income.
S_t	Local service income.
$(V_1)t$	Total received income.
$(v_2)t$	Total produced income.
K_t	Total capital stock.
$(K_m)t$	Manufacturing capital stock.
$(K_{nm})t$	Nonmanufacturing capital stock.
$(I_m)t$	Investment in manufacturing sector.
$(I_{nm})t$	Investment in nonmanufacturing sector.
L_t	Employment.
(No)t	Labor supply (actual).
(Ne)t	Expected labor supply (natural increase).
(Po)t	Population (actual).
(Pe)t	Expected population (natural increase).
W_t	Annual wage per employee.
M_t	Migration.
U_t	Unemployment

Predetermined Variables

GNPt	Gross national product.
(B-D)t	Birth rate (per thousand) minus the death rate (per thousand)
(Ne-L)t-1	Prospective unemployment (difference between natural increase in the labor force and labor demand).
$(K_m)t-1$	Capital stock in manufacturing.
$(K_{nm})t-1$	Capital stock in nonmanufacturing.
t	Time.

Equations

1. $X_t = \underset{(103.86)}{430.55} + \underset{(.329)}{6.71}\ GNP$ (OLS)

$R^2 = .967$
D.W. = 1.114

2. $S_t = -135.1 + .7297\ (V_1)_t$ (RFLS)

3. $(\log K_t - \log K_{t-1})_m = \underset{(1.007)}{.5113}$ (2SLS) $+ \underset{(.289)}{.939} \log X_t^*$
$- \underset{(.211)}{1.023} \log K_{t-1} - \underset{(.0032)}{.0062}_t$

$R^2 = .712$
D.W. - 1.447

4. $(\log K_t)_{nm} = \underset{(.2265)}{.8389} + \underset{(.096)}{.798} \log S_t^*$ (2SLS)

$R^2 = .927$
D.W. - 1.251

5. $(V_2) = 6422\ K^{.29}\ L^{.71}\ \underset{(.00128)}{(1.013)}^t$ (Factor Shares OLS)

6. $(Ne)_t = \underset{(.00027)}{.4009}(Pe)_t$ (OLS)

$R^2 = .988$
D.W. = 1.465

7. $M_t = \underset{(33.63)}{106.22} - \underset{(.279)}{1.0385}\ (Ne-L)_{t-1}$ (OLS)

$R^2 = .500$
D.W. = 1.504

8. $W_t = 2657\ \underset{(.0011)}{(1.017)}^t$ (OLS)

$R^2 = .944$
D.W. = 1.533

Definitions and Identities

9. $Pe = (Po)_{t-1} + (B - D)(Po)_{t-1}$

10. $(No)_t = .4009\ (Pe)_t + .4009\ M_t$

11. $(V_2)_t/(V_1)_t = .907$

12. $(V_1) = S_t + X_t$

13. $U_t = (No)_t - B_t$

14. $K_t = (K_t)_m + (K_t)_{nm}$

All variables are statistically significant at the 5 per cent level including the reduced-form least-squares (not shown). Hypotheses of positive autocorrelation rejected at the 5 per cent level for all equations. Asterisk indicates computed values.

An Econometric Model of Ohio

Endogenous Variables

A	Sales by all new car dealers in Ohio.
AR	Automobile registrations in Ohio.
ΔAR	Annual change in AR.
C	Sales by all establishments selling at the retail level in Ohio.
DPI	Ohio disposable personal income.
ΔDPI	Annual change in DPI.
F_T	Gallons of taxable motor fuel sold in Ohio.
FIT	Federal income taxes of Ohio. (PI-DPI)
GSP	Ohio's Gross State Product.
ΔGSP	Annual change in Ohio's Gross State Product.
GSP_{cc}	Gross State Product in contract construction.
GSP_{fi}	Gross State Product in finance, insurance, and real estate.
$GSP_{(known)}$	$GSP_{ma} + GSP_{cc} + GSP_{td} + GSP_{so} + GSP_{fi} + GSP_{fg} + GSP_{slg}$
GSP_{ma}	GSP originating in manufacturing in Ohio.
ΔGSP_{ma}	Annual change in GSP_{ma}.
$GSP_{(other)}$	$GSP - GSP_{(known)}$. $GSP_{(other)}$ is also the sum of gross state products in agriculture (GSP_{agri}), mining (GSP_{min}), transportation (GSP_t) and communications and public utilities (GSP_{cpu}).
$\Delta GSP_{(other)}$	$GSP_{(other)} - GSP_{(other) - 1}$
GSP_{so}	Gross State Product in services and other.
GSP_{td}	Gross State Product in trade.
IGF_{ma}	"Internally Generated Funds" in manufacturing (profit-type income originating in manufacturing plus capital consumption allowances originating in manufacturing) in Ohio.
I_{ma}	Total investment expenditures for plant (structures) and machinery by all manufacuring establishments (existing, and those not yet in operation) in Ohio.
I_{mma}	Investment expenditures for machinery by all manufacturing establishments in Ohio.
I_{sma}	Investment expenditures for plant (structures) by all manufacturing establishments in Ohio.

PI	Personal income in Ohio.
R	Retail sales in Ohio excluding new car dealer sales. (R = C - A).
T_s	Retail sales tax receipts.

Predetermined Variables

AR_{-1}	Last year's AR in Ohio.
$\Delta AC/AC = (AC-AC_{-1})/AC$	AC represents dollars of automobile installment credit outstanding in the U.S.
DPI_{-1}	Last year's DPI in Ohio.
ΔGNP_{ma}	Change in gross national product in manufacturing.
GSP_{-1}	Last year's Ohio GSP.
GSP_{fg}	Gross State Product in federal government.
$GSP_{(known)-1}$	Last year's $GSP_{(known)}$
GSP_{ma-1}	Last year's GSP_{ma} in Ohio.
$GSP_{(other)-1}$	Last year's $GSP_{(other)}$.
GSP_{slg}	Gross State Product in state and local government
HP	New housing units authorized in permit issuing places in Ohio.
IGF_{ma-1}	Last year's IGF_{ma} in Ohio.
IS_{ma-1}	Last year's IS_{ma} in Ohio.
MPC	Military prime contracts awarded in Ohio.
RCB	Interest rate on corporate bonds.
RTBS	Interest rate on 90-day U.S. Treasury bills.

Equations (The OLS and TSLS estimates are shown)

1. $$R = \underset{\substack{(0.376)\\ 9.96}}{3.741} + \underset{\substack{(0.031)\\ 14.30}}{0.305}\, DPI \quad \text{(OLS)}$$

$$\hat{R}^2 = 0.94 \qquad 1949\text{-}1963$$

1'. $$R = \underset{\substack{(0.427\\ 8.84}}{3.780} + \underset{\substack{(0.024)\\ 12.48}}{0.303}\, DPI \quad \text{(TSLS)}$$

1949-1963

2. $$A = \underset{\substack{(0.450)\\-2.39}}{-1.075} + \underset{\substack{(0.090)\\3.42}}{0.306}\,DPI + \underset{\substack{(0.301)\\2.04}}{0.613}\,\Delta AC/AC - \underset{\substack{(0.396)\\-2.24}}{0.888}\,AR_{-1} \quad (OLS)$$

$\hat{R}^2 = 0.77$ 1949-1963

2'. $$A = \underset{\substack{(0.520)\\-1.91}}{-1.0126} + \underset{\substack{(0.108)\\2.71}}{0.292}\,DPI + \underset{\substack{(0.337)\\1.85}}{0.624}\,(\Delta AC)/AC - \underset{\substack{(0.475)\\-1.74}}{0.825}\,AR_{-1} \quad (TSLS)$$

1949-1963

3. $C = A + T$

4. $$I_{sma} = \underset{\substack{(0.101\\2.85}}{0.288} + \underset{\substack{(0.093)\\2.82}}{0.263}\,I_{mma} - \underset{\substack{(0.017)\\-3.48}}{0.058}\,RCB \quad (OLS)$$

$\hat{R}^2 = 0.67$ 1951-1963

5. $$I_{mma} = \underset{\substack{(0.434)\\-2.65}}{-1.150} + \underset{\substack{(0.101\\1.42}}{0.144}\,IGF_{mn} + \underset{\substack{(0.094)\\4.06}}{0.384}\,IGF_{ma-1}$$

$$+ \underset{\substack{(0.440)\\2.09}}{0.919}\,I_{mna-1} + \underset{\substack{(0.037)\\1.71}}{0.064}\,RTRS \quad (OLS)$$

$\hat{R}^2 = 0.68$ 1952-1968

6. $I_{ma} = I_{sma} + I_{mma}$

7. $$IGF_{ma} = \underset{\substack{(0.208)\\2.40}}{0.501} + \underset{\substack{(0.036)\\4.40}}{0.156}\,\Delta GSP_{ma} + \underset{\substack{(0.019)\\10.35}}{0.193}\,GSP_{ma} \quad (OLS)$$

$\hat{R}^2 = 0.92$ 1948-1965

8. $$PI = \underset{\substack{(0.801)\\-2.71}}{-2.161} + \underset{\substack{(0.031)\\27.53}}{0.865}\,GSP - \underset{\substack{(0.082)\\-3.14}}{0.259}\,\Delta GSP \quad (OLS)$$

$\hat{R}^2 = 0.98$ 1948-1963

8'. $$PI = \underset{\substack{(1.587)\\-2.57}}{-4.075} + \underset{\substack{(0.059)\\15.65}}{0.926}\,GSP + \underset{\substack{(0.042)\\1.54}}{0.065}\,\Delta GSP \quad (TSLS)$$

1949-1963

9. $DPI = PI - FIT$

10. $\Delta DPI = DPI - DPI_{-1}$

11. $FIT = -0.902 + 0.169\ PI$ (OLS)
(0.204) (0.011)
-4.42 15.95

$\hat{R}^2 = 0.94$ 1946-1963

11'. $FIT = -0.995 + 0.173\ PI$ (TSLS)
(0.303) (0.015)
-3.29 11.53

1946-1963

12. $\Delta GSP_{ma} = -0.515 + 0.115\ GNP_{ma} + 0.263\ MPC$ (OLS)
(0.099) (0.005) (0.077)
-5.18 21.90 3.39

$\hat{R}^2 = 0.97$ 1951-1965

13. $GSP_{td} = -1.682 + 0.343\ A + 0.552\ R$ (OLS)
(0.413) (0.177) (0.070)
-4.07 1.94 7.84

$\hat{R}^2 = 0.96$ 1947-1964

13'. $GSP_{td} = -2.234 + 0.039\ A + 0.671\ R$ (TSLS)
(0.447) (0.248) (0.0843)
-5.00 0.16 7.95

1949-1963

14. $GSP_{cc} = -0.055 + 2.344\ I_{sma} + 0.013\ HP$ (OLS)
(0.216) (0.338) (0.003)
-0.26 6.93 3.94

$\hat{R}^2 = 0.85$ 1954-1963

15. $GSP_{fi} = -0.919 + 0.197\ DPI = 0.096\ \Delta DPI$ (OLS)
(0.092) (0.005) (0.029)
-10.03 36.84 -3.33

$\hat{R}^2 = 0.99$ 1947-1963

15'. $$GSP_{fi} = -1.045 + 0.203\ DPI - 0.082\ \Delta DPI \quad \text{(TSLS)}$$
(0.112) (0.006) (0.031)
-9.29 32.17 -2.66

1949-1963

16. $$GSP_{so} = -1.094 + 0.141\ DPI + 0.082\ \Delta DPI \quad \text{(OLS)}$$
(0.121) (0.007) (0.036)
-0.91 19.94 2.30

$\hat{R}^2 = 0.97$ 1950-1963

16'. $$GSP_{so} = -0.470 + 0.148\ DPI = 0.024\ \Delta DPI \quad \text{(TSLS)}$$
(0.154) (0.009) (0.042)
-3.04 17.14 -0.56

1949-1963

17. $$\Delta GSP_{(other)} = 0.020 + 0.073\ \Delta GSP_{(known)} \quad \text{(OLS)}$$
(0.027) (0.019)
0.73 3.85

$\hat{R}^2 = 0.45$ 1948-1965

17'. $$\Delta GSP_{(other)} = 0.016 + 0.091\ \Delta GSP_{(known)} \quad \text{(TSLS)}$$
(0.024) (0.018)
0.64 5.19

1949-1963

18. $$\Delta GSP = \Delta GSP_{(other)} + \Delta GSP_{(known)}$$

19. $$GSP = GSP_{-1} + \Delta GSP$$

20. $$GSP_{(known)} = GSP_{ma} + GSP_{cc} + GSP_{td} + GSP_{so} + GSP_{fi} + GSP_{fg} + GSP_{slg}$$

21. $$\Delta GSP_{(known)} = GSP_{(known)} - GSP_{(known)-1}$$

22. $$GSP_{(other)} = GSP_{agri} + GSP_{min} + GSP_{t} + GSP_{cpu} = GSP_{(other)-1} + \Delta GSP_{(other)}$$

23. $$GSP_{ma} = GSP_{ma-1} + \Delta GSP_{ma}$$

24. $F_t = -0.115 + 0.902\ AR$ (OLS)

$$\begin{array}{ll} (0.073) & (0.024) \\ -1.59 & 37.76 \end{array}$$

$\hat{R}^2 = 0.99$ 1945-1964

25. $\Delta AR = 0.107 + 0.170\ A - 0.087\ AR_{-1}$ (OLS)

$$\begin{array}{lll} (0.039) & (0.035) & (0.017) \\ 2.77 & 4.90 & -4.88 \end{array}$$

$\hat{R}^2 - 0.95$ 1948-1963

26. $T_s = -0.085 + 0.028\ C$ (OLS)

$$\begin{array}{ll} (0.021) & (0.002) \\ -4.07 & 14.00 \end{array}$$

$\hat{R}^2 = 0.93$ 1947-1964

27. $AR = AR_{-1} + \Delta AR$

APPENDIX B

APPENDIX B

VARIABLE PARTICIPATION MATRIX OF THE COMPLETE MODEL: CHAPTER III

Block I

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	MPI	*	*													
2.	MWS		*	*							*	*	*	*	*	*
3.	WS^{MFG}			*	*		*	*	*	*						
4.	WS^{371}				*	*										
5.	EMP^{371}					*										
6.	WS^{OD}				*		*									
7.	WS^{FAK}							*								
8.	WS^{TEX}								*							
9.	WS^{OND}									*						
10.	WS^{TCU}			*							*					
11.	WS^{MIN}											*				
12.	WS^{CC}												*			
13.	WS^{WT}	*												*		
14.	WS^{RT}	*													*	
15.	WS^{SER}	*														*

Block II

		1	2	3	4	5	6	7	8	9
1.	MPI	*								
2.	MNWS		*	*	*	*	*	*		
3.	OLI			*						
4.	PROPNF	*			*					
5.	PROPY					*				
6.	TRANS						*			
7.	CFSJ							*	*	
8.	TECFSS								*	*
9.	EECFSS									*

APPENDIX C

APPENDIX C

ORDINARY AND TWO-STAGE LEAST SQUARES RESULTS: CHAPTER III

<u>Block I: Wage and Salary Disbursements</u>

$$WS^{371} = -786.6639 + \underset{(14.3645)}{28.0010}q_1 - \underset{(14.4030)}{12.0039}q_2 + \underset{(14.8868}{7.3496}q_3 + \underset{(0.1070)}{1.8140}EMP^{371} + \underset{(11.8801)}{318.7459}w^{371}$$

$R^2 = .960$ $\underline{d} = 1.676$ (2SLS)

$$EMP^{371} = \underset{(44.4014)}{429.4879} + \underset{(14.8005)}{5.1030}q_1 - \underset{(14.8163)}{5.0678}q_2 + \underset{(20.3843)}{26.6458}q_3 + \underset{(0.0183)}{0.0742}USAP - \underset{(0.0150)}{0.0701}K^{37}_{-1} + \underset{(23.6825)}{117.6889}d_N$$

$R^2 = .513$ $\underline{d} = 0.616$ (OLS)

$$WS^{OD} = \underset{(28.7476)}{70.5578} - \underset{(16.8880)}{55.1828}q_1 - \underset{(20.3853)}{43.8998}q_2 - \underset{(23.4568)}{84.4439}q_3 + \underset{(0.1333)}{0.2146}WS^{371} + \underset{(1.8734)}{12.4379}MFGDNO_{-1}$$

$R^2 = .954$ $\underline{d} = 0.706$ (2SLS)

$$WS^{FAK} = \underset{(57.7883)}{316.9208} - \underset{(1.2260)}{6.9370}q_1 - \underset{(1.2252)}{2.9810}q_2 + \underset{(1.2231)}{3.0999}q_3 + \underset{(0.0498)}{0.9239}TIME - \underset{(49.3541)}{232.0048}MUSAHE_{-8}$$

$R^2 = .942$ $\underline{d} = 1.154$ (OLS)

$$WS^{TEX} = \underset{(2.0090)}{-20.5785} - \underset{(0.8457)}{1.2234}q_1 - \underset{(0.8456)}{0.1463}q_2 + \underset{(0.8456)}{0.1443}q_3 + \underset{(0.0183)}{0.3967}AWE^{371} + \underset{(0.9845)}{6.4143}d_N$$

$R^2 = .969$ $\underline{d} = 1.248$ (OLS)

$$WS^{OND} = \underset{(8.4593)}{14.1509} - \underset{(3.6213)}{13.3704}q_1 - \underset{(3.6193)}{11.0155}q_2 - \underset{(3.6192)}{9.2528}q_3 + \underset{(0.0148)}{0.3915}GNP$$

$R^2 = .938$ $\underline{d} = 0.342$ (OLS)

$$WS^{TCU} = \underset{(33.1669)}{-83.9192} - \underset{(2.0532)}{19.0042}q_1 - \underset{(2.0964)}{7.4597}q_3 - \underset{(2.9209)}{9.9544}q_3 + \underset{(0.0056)}{0.0845}WS^{MFG} - \underset{(0.0032)}{0.0206}USAP + \underset{(0.0052)}{0.0247}POP_{-1}$$

$R^2 = .984$ $\underline{d} = 1.181$ (2SLS)

$$WS^{MIN} = \underset{(4.9655)}{14.5642} - \underset{(0.5713)}{3.4399}q_1 - \underset{(0.5807)}{1.0555}q_2 - \underset{(0.5784)}{1.0800}q_3 - \underset{(2.4358)}{0.1531}w^{MIN} - \underset{(0.0475)}{0.1951}TIME + \underset{(0.0293)}{0.1885}MFGNO_{-1}$$

$R^2 = .693$ $\underline{d} = 0.811$ (OLS)

$$WS^{CC} = \underset{(20.4906)}{34.0838} - \underset{(6.9694)}{54.5818}q_1 - \underset{(6.9841)}{24.3327}q_2 + \underset{(6.9936)}{13.9353}q_3 + \underset{(8.6936)}{31.1091}w^{CC} + \underset{(0.0502)}{0.5091}(K^{MFG} - k^{MFG}_{-1})$$

$R^2 = .927$ $\underline{d} = 0.770$ (OLS)

$$WS^{WT} = \underset{(3.2419)}{10.7164} - \underset{(3.0120)}{16.7807}q_1 - \underset{(2.0250)}{13.7226}q_2 - \underset{(1.8800)}{7.2221}q_3 + \underset{(0.0032)}{0.0148}MPI + \underset{(0.0941)}{0.6060}WS^{WT}_{-1}$$

$R^2 = .991$ $\underline{d} = 2.179$ (2SLS)

$$WS^{RT} = \underset{(4.1878)}{2.8182} - \underset{(4.3429)}{38.5943}q_1 - \underset{(2.3184)}{9.4634}q_2 - \underset{(2.5923)}{11.7995}q_3 + \underset{(0.0052)}{0.0296}MPI + \underset{(0.0840)}{0.5673}WS^{RT}_{-1}$$

$R^2 = .996$ $\underline{d} = 2.256$ (2SLS)

$$WS^{SER} = \underset{(13.9776)}{-50.0735} - \underset{(4.3426)}{25.0113}q_1 - \underset{(2.6034)}{1.5664}q_2 - \underset{(2.7745)}{0.6955}q_3 + \underset{(0.0065)}{0.0372}MPI + \underset{(0.1042)}{0.4330}WS^{SER}_{-1} + \underset{(0.2343)}{0.4502}CPI_M$$

$R^2 = .997$ $\quad\quad$ $\underline{d} = 2.237$ $\quad$ (2SLS)

$$WS^{MFG} = WS^{371} + WS^{OD} + WS^{FAK} + WS^{TEX} + WS^{OND}$$

$$MWS = WS^{FARM} + WS^{MIN} + WS^{CC} + WS^{MFG} + WS^{WT} + WS^{RT} + WS^{TCU} + WS^{FIRE} + WS^{SER} + WS^{GOV}$$

$$+ WS^{OI}$$

$$MPI = MWS + MNWS$$

Block II: Other Sources of Personal Income

$$OLI = \underset{(4.4235)}{57.7031} - \underset{(4.4963)}{0.7273}q_1 - \underset{(4.4963)}{0.9042}q_2 - \underset{(4.4963)}{1.3734}q_3 + \underset{(6.4494)}{147.4682}LICMFG + \underset{(0.0297)}{0.2587}MICMFG$$

$R^2 = .980$ $\quad\quad$ $\underline{d} = 0.460$ $\quad$ (OLS)

$$PROPNF = \underset{(146.2988)}{-59.2905} - \underset{(10.5745)}{43.6109}q_1 - \underset{(5.5713)}{18.2558}q_2 - \underset{(5.6088)}{13.3489}q_3 + \underset{(0.0121)}{0.0843}MPI - \underset{(0.1399)}{0.0713}PROPNF_{-1}$$

$$- \underset{(0.6975)}{2.7684}CPI_M + \underset{(0.0262)}{0.0501}POP_{-1}$$

$R^2 = .981$ $\quad\quad$ $\underline{d} = 1.748$ $\quad$ (2SLS)

$$PROPY = \underset{(9.8790)}{83.6703} - \underset{(7.6308)}{62.0371}q_1 - \underset{(8.4028)}{32.1868}q_2 - \underset{(7.8681)}{46.5154}q_3 + \underset{(0.0048)}{0.0130}USCP^{MFG}_{-1} + \underset{(0.0019)}{0.0439}ML_{-1}$$

$R^2 = .992$ $\underline{d} = 1.435$ (OLS)

$$TRANS = \underset{(153.0681)}{-204.5558} - \underset{(5.9426)}{3.0464}q_1 - \underset{(5.7164)}{1.8847}q_2 - \underset{(5.5772)}{9.0664}q_3 + \underset{(0.0265)}{0.3233}UEMP + \underset{(0.2932)}{0.4727}POP^{65+}_{-1}$$

$$+ \underset{(0.4800)}{2.0322}MED_{-1} + \underset{(0.2878)}{0.5203}OAS_{-1} + \underset{(0.0507)}{0.2378}[(MAXTY)(SSR)]$$

$R^2 = .986$ $\underline{d} = 1.402$ (OLS)

$$EECFSS = \underset{(1.9874)}{7.0571} + \underset{(0.0097)}{0.4219}[(SSR)(MWS)(q_1)] + \underset{(0.0028)}{0.1267}\{[(SSR)(MAXTY)(EMP^{WS})] - (EECFSS_{-1})]\}(q_2)$$

$$+ 0.1195\{[(SSR)(MAXTY)(EMP^{WS})] - (EECFSS_{-1} + EECFSS_{-2})\}(q_3)$$

$$+ 0.0859\{[(SSR)(MAXTY)(EMP^{WS})] - (EECFSS_{-1} + EECFSS_{-2} + EECFSS_{-2})\}(q_4)$$

$R^2 = .984$ $\underline{d} = 2.062$ (OLS)

$$CFSI = \underset{(1.1223)}{14.0286} - \underset{(1.4366)}{8.9132}q_1 - \underset{(1.4386)}{7.2491}q_2 - \underset{(1.3805)}{8.4795}q_3 + \underset{(0.0094)}{1.1776}TECFSS$$

$R^2 = .997$ $\underline{d} = 1.120$ (2SLS)

$$TECFSS = EECFSS + SECFSS$$

$$MNWS = OLI + PROPF + PROPNF + PROPY + TRANS - CFSI$$

$$MPI = MNWS + MWS$$

APPENDIX D

APPENDIX D

SOURCES AND CONSTRUCTION OF SAMPLE DATA

CHAPTER III

The principle source of information was the 1971 Economic Report of the Governor, hereafter referred to as the Economic Report. In addition, two other governmental agencies, the U. S. Department of Commerce, Office of Business Economics (OBE) and the Michigan Department of Labor, Michigan Employment Security Commission (MESC) provided valuable information and insights into the data problems encountered in preparing this document.

Computation

WS^{FARM} Payrolls in farms (millions of dollars).

WS^{FARM} = (1a)

WS^{MIN} Payrolls in mining (millions of dollars).

WS^{MIN} = (1b)

WS^{CC} Payrolls in contract construction (millions of dollars).

WS^{CC} = (1c)

WS^{MFG} Payrolls in manufacturing (millions of dollars).

WS^{MFG} = (1f)

WS^{371} Payrolls in motor vehicles and equipment (millions of dollars).

$WS^{371} = (2a)$

WS^{OD} Payrolls in other durable goods manufacturing (millions of dollars).

$WS^{OD} = (2d) - (2a)$

WS^{FAK} Payrolls in food and kindred products (millions of dollars).

$WS^{FAK} = (2b)$

WS^{TEX} Payrolls in textile mill products and apparel (millions of dollars).

$WS^{TEX} = (2c)$

WS^{OND} Payrolls in other nondurable goods manufacturing (millions of dollars).

$WS^{OND} = (1f) - (2d) - (2b) - (2c)$

WS^{WT} Payrolls in wholesale trade (millions of dollars)

$WS^{WT} = (2e)$

WS^{RT} Payrolls in retail trade (millions of dollars).

$WS^{RT} = (1g) - (2e)$

WS^{FIRE} Payrolls in finance, insurance, and real estate (millions of dollars).

$WS^{FIRE} = (1h)$

WS^{TCU} Payrolls in transportation, communications, and public utilities (millions of dollars).

$WS^{TCU} = (1i)$

WS^{SER} Payrolls in services (millions of dollars).

$WS^{SER} = (1j)$

WS^{GOV} Payrolls in government (millions of dollars).

WS^{GOV} = (1k)

WS^{OI} Payrolls in other industries (millions of dollars).

WS^{OI} = (1l)

MWS Total payrolls (wage and salary disbursements (millions of dollars).

MWS = (1b)

OLI Other labor income (millions of dollars).

OLJ = (1n)

PROPF Farm proprietors' income (millions of dollars).

PROPF = (7)1/4

PROPNF Nonfarm proprietors' income (millions of dollars).

PROPNF = (1o) - (7)1/4

PROPY Property income (millions of dollars).

PROPY = (1p)

TRANS Transfer payments (millions of dollars).

TRANS = (1q)

EECFSS Employee contributions for social security (millions of dollars).

EECFSS = (5)

SECFSS Self-employed contributions for social security (millions of dollars).

SECFSS = (6)

TECFSS Total contributions for social security (millions of dollars).

TECFSS = (5) + (6)

CFSI Total contributions for social insurance (millions of dollars).

CFSI = (1r)

MNWS Total nonwage and salary components of personal income (millions of dollars).

MNWS = (1m)

MPI Michigan personal income (millions of dollars).

MPI = (1a)

USAP U.S. automobile production (millions of dollars).

USAP = (8)

GNP U.S. gross national product (billions of dollars).

GNP = (9)

MFGNO U.S. new orders in manufacturing (billions of dollars).

MFGNO = (10)

MFGDNO U.S. new order in durable goods manufacturing (billions of dollars).

MFGDNO = (11)

K^{MFG} Capital stock in manufacturing, deflated (billions of dollars).

K^{MFG} = (12)

K^{37} Capital stock in transportation equipment, deflated (billions of dollars).

K^{37} = (13)

TIME — Time.

TIME = (14)

POP — Population, end of quarter (thousands).

POP = (15)

POP^{65+} — Population 65 and older, end of quarter (thousands).

$POP^{65+} = (16)$

AWH^{371} — Average quarterly weekly hours in SIC 371.

$AWH^{371} = (17)$

AWE^{371} — Average quarterly weekly earnings in SIC 371 (dollars).

$AWE^{371} = (17) \times (32)$

MUSAHE — Ratio of Michigan to U.S. average hourly earning in manufacturing.

MUSAHE = (18)/(19)

EMP^{WS} — Average quarterly total wage and salary employment (thousands).

$EMP^{WS} = (4)$

LICMFG — Employer contributions for employee group life, accident, and sickness insurance (dollars).

LICMFG = (20)

MICMFG — Employer contributions for employee medical expenses (dollars).

MICMFG = (21)

CPI^{MED} — Detroit average quarterly consumer price index, medical care component.

$CPI^{MED} = (22)$

SSR	Social security tax rate (per cent).
	SSR = (23)
MAXTY	Maximum taxable earnings subject to the social security tax (dollars).
	MAXTY = (24)
$USCP^{MFG}$	U.S. corporate profits in manufacturing, net after taxes (billions of dollars).
	$USCP^{MFG}$ = (25)
USDIV	U.S. dividends paid, cash, all industries (billions of dollars).
	USDIV = (26)
ML	Michigan liquid assets (billions of dollars).
	ML = (27)
UEMP	Average quarterly number of unemployed (thousands).
	UEMP = (28)
OAS	Social security payment to Michigan residents (millions of dollars).
	OAS = (29)
MED	Total public medical assistance payments (millions of dollars).
	MED = (30)
w^{371}	Hourly wage rate for assemblers in SIC 371 (dollars).
	w^{371} = (32)
w^{MIN}	Hourly wage rate for iron and copper ore miners (dollars).
	w^{MIN} = (33)

w^{CC} Hourly wage rate for common laborers (dollars).

w^{CC} = (34)

USMINW U.S. minimum wage rate (dollars).

USMINW = (32)

Sources

1. Michigan quarterly personal income by major sources:

   a. Total personal income
   b. Total wage and salary disbursements
   c. Farms
   d. Mining
   e. Contract construction
   f. Manufacturing
   g. Wholesale and retail trade
   h. Finance, insurance, and real estate
   i. Transportation, communications, and public utilities
   j. Services
   k. Government
   l. Other industries
   m. Total other sources of personal income
   n. Other labor income
   o. Proprietors' income
   p. Property income
   q. Transfer payments
   r. Contributions for social insurance

1955-1959	Unpublished data from the State of Michigan, Executive Office, Bureau of Programs and Budget.
1960-1968	Economic Report, Appendix Table B-11

2. Michigan quarterly payrolls for the following categories:

   a. Motor vehicles and equipment (SIC 371)
   b. Food and kindred products
   c. Textile mill products and apparel
   d. Durable goods manufacturing
   e. Wholesale trade

   Annual Report of the Michigan Employment Security Commission, each year.

3. Employment in motor vehicles and equipment, quarterly average: constructed by averaging monthly data in the Annual Report of the Michigan Employment Security Commission, each year.

4. Total wage and salary employment, quarterly average: constructed by averaging monthly data in the Annual Report of the Michigan Employment Security Commission, each year.

5. Employee contributions for social security, quarterly: Information by letter from the U.S. Department of Health, Education, and Welfare, Social Security Administration, dated April 26, 1970.

6. Self-employed contributions for social security, annual: Information by letter from the U.S. Department of Health, Education, and Welfare, Social Security Administration, dated April 26, 1970.

7. Farm proprietors' income, annual:

1956-1965	Latest revisions were provided from unpublished data from O.B.E. by letter, dated January 12, 1971.
1966-1968	Survey of Current Business (O.B.E.), August 1970, p. 36.

8. U.S. automobile production, quarterly: Automobile Facts and Figures, Automobile Manufacturing Association, assorted issues.

9. U.S. gross national product: 1969 Business Statistics (O.B.E.), pp. 4 and 193.

10. U.S. new orders in manufacturing: 1969 Business Statistics (O.B.E.), pp. 33 and 213.

11. U.S. new orders in durable goods manufacturing: 1969 Business Statistics (O.B.E.), pp. 33 and 213.

12. Capital stock in manufacturing, end of quarter, in constant dollars (1958 = 100): Unpublished data from the State of Michigan, Executive Office, Bureau of Programs and Budget.

13. Capital stock in transportation equipment (SIC 37), end of quarter, in constant dollars (1950 = 100): Unpublished data from the State of Michigan, Executive Office, Bureau of Programs and Budget.

14. Time: 1950 I = 1.

15. Population, as of July 1 of each year: Economic Report, Appendix Table B-1.

    Intervening end of quarter data by interpolation.

16. Population 65 and older: Unpublished data from the State of Michigan, Executive Office, Bureau of Programs and Budget.

17. Average quarterly weekly hours in SIC 371: constructed from unpublished monthly data provided by M.E.S.C. by letters, dated April 11, 1968 and November 20, 1969.

18. Michigan average hourly earnings in manufacturing, annual: Economic Report, Appendix Table B-25.

19. U.S. average hourly earnings, in manufacturing, annual: Economic Report, Appendix Table B-25.

20. Employer contribution for employee group life, accident and sickness insurance, annual: Unpublished data from the State of Michigan, Executive Office, Bureau of Programs and Budget.

21. Employer contributions for employee medical expenses, annual: Unpublished data from the State of Michigan, Executive Office, Bureau of Programs and Budget.

22. Detroit average quarterly consumer price index, medical care component: constructed from monthly data contained in the Consumer Price Index (U.S. Department of Labor, Bureau of Labor Statistics), each month.

23. Social security tax rate: Complete historical series provided by letter from the U.S. Department of Health, Education and Welfare, Social Security Administration, dated April 3, 1969.

24. Maximum taxable earnings subject to the social security tax: Complete historical series provided by letter from the U.S. Department of Health, Education and Welfare, Social Security Administration, dated April 3, 1969.

25. U.S. corporate profits in manufacturing, net after taxes:

1955-58	1959 Business Statistics (OBE), p. 97.
1959-60	1961 Business Statistics (OBE), p. 96.
1961-62	1963 Business Statistics (OBE), p. 101.
1963-64	1967 Business Statistics (OBE), p. 101.
1965-68	1969 Business Statistics (OBE), p. 101.

26. U.S. dividends paid, cash, all industries:

1955-58	1959 Business Statistics (OBE), p. 97.
1959-60	1961 Business Statistics (OBE), p. 96.
1961-62	1965 Business Statistics (OBE), p. 101.
1963-64	1967 Business Statistics (OBE), p. 101.
1965-68	1969 Business Statistics (OBE), p. 101.

27. Liquid assets, end of year: Economic Report, Appendix Table B-35. Intervening end of quarter information by interpolation.

28. Average quarterly number of unemployed: constructed from monthly information contained in the Annual Report of the Michigan Employment Security Commission, each year.

29. Social security payments to Michigan residents: Information provided by letter from the U.S. Department of Health, Education, and Welfare, Social Security Administration, January 26, 1970.

30. Total public medical assistance payments: Information provided by letter from the State of Michigan, Department of Social Services, Research Section, dated April 21, 1969.

31. U.S. minimum wage rate: Information provided by letter from the U.S. Department of Labor, Wage and Labor Standards Administration, dated June 18, 1968.

32. Hourly wage rate for assemblers in SIC 371:

1955-1966	Wage Chronology, General Motors Corporation, 1939-1966, U.S. Department of Labor, Bureau of Labor Statistics, October, 1966.
1967-1968	By telephone from the United Automobile Workers of America, July 9, 1969.

33. Hourly wage rate for iron and copper ore miners: Information provided by letter from United Steel Workers of America, dated September 17, 1969.

34. Hourly wage rate for common laborers: Information provided by letter from Laborer's International Union of North America, dated September 2, 1969.

WS^{FARM}

1-

YEAR	1	2	3	4
1956	7.50	11.90	13.10	11.50
1957	8.70	15.00	14.30	12.10
1958	10.20	15.80	14.40	12.60
1959	8.50	16.10	17.10	15.30
1960	8.90	16.00	16.70	13.40
1961	8.80	15.90	16.30	14.00
1962	8.40	16.20	16.40	13.90
1963	8.80	16.70	16.60	14.80
1964	8.70	15.50	16.60	15.20
1965	7.60	14.00	15.50	13.90
1966	8.00	14.30	15.40	13.30
1967	8.50	14.70	15.40	12.30
1968	12.80	12.90	13.10	14.20

WS^{MIN}

2-

YEAR	1	2	3	4
1956	20.70	23.60	22.50	26.10
1957	22.50	25.30	25.60	24.60
1958	19.70	18.80	19.60	21.90
1959	19.60	23.20	19.30	19.80
1960	20.70	24.60	25.70	25.00
1961	19.60	21.00	22.20	22.30
1962	18.80	21.30	21.60	21.30
1963	17.90	21.40	21.60	22.10
1964	19.50	22.30	22.80	23.40
1965	20.80	23.50	24.90	25.80
1966	22.60	25.70	26.30	26.40
1967	22.50	26.20	25.80	23.50
1968	21.90	26.40	27.10	27.60

WS^{CC}

3-

YEAR	1	2	3	4
1956	128.50	158.50	194.60	187.40
1957	124.70	147.40	169.60	165.30
1958	107.80	128.40	150.20	145.70
1959	97.30	142.90	174.70	156.10
1960	105.30	136.10	174.90	153.80
1961	102.70	136.60	163.80	149.90
1962	98.00	131.00	163.10	153.90
1963	104.00	149.90	190.30	180.80
1964	133.50	171.80	216.80	209.00
1965	156.10	217.30	257.50	266.10
1966	214.20	266.90	314.90	274.80
1967	213.90	268.80	314.30	295.00
1968	242.70	255.00	321.20	339.10

WS^{MFG}

YEAR	1	2	3	4
1956	1593.30	1484.10	1432.10	1636.00
1957	1553.80	1539.50	1483.60	1518.00
1958	1415.50	1287.30	1271.80	1450.40
1959	1465.40	1532.10	1508.90	1555.50
1960	1564.20	1586.30	1556.20	1535.30
1961	1417.90	1443.30	1422.70	1574.00
1962	1515.00	1635.20	1594.00	1731.70
1963	1762.80	1758.60	1717.20	1896.40
1964	1954.60	1946.70	1925.40	2040.30
1965	2102.20	2176.40	2109.90	2423.50
1966	2334.50	2348.50	2380.00	2506.00
1967	2423.00	2358.70	2367.30	2419.30
1968	2466.00	2656.80	2581.50	2828.70

WS^{371}

6-

YEAR	1	2	3	4
1956	673.10	561.30	527.00	645.20
1957	656.60	564.30	536.00	549.20
1958	504.90	409.50	395.30	467.30
1959	536.60	514.30	501.80	504.40
1960	618.70	531.20	526.10	535.40
1961	491.30	465.00	449.30	532.10
1962	577.20	550.70	538.00	610.30
1963	681.30	634.70	608.50	704.50
1964	765.80	717.80	699.50	724.50
1965	838.10	811.80	760.40	924.30
1966	918.80	845.10	858.00	905.20
1967	911.30	324.40	848.50	854.20
1968	1070.40	1003.50	969.60	1075.50

WS^{OD}

7-

YEAR	1	2	3	4
1956	667.00	661.40	640.60	712.20
1957	725.80	705.20	670.10	684.40
1958	655.60	621.50	615.40	703.50
1959	670.30	742.80	721.50	759.30
1960	773.50	769.50	733.90	703.70
1961	652.00	691.80	675.40	737.00
1962	744.10	780.10	745.10	801.40
1963	774.90	807.80	784.80	852.50
1964	864.00	894.60	883.20	953.60
1965	925.80	1010.40	978.30	1105.00
1966	1052.10	1126.10	1119.70	1185.00
1967	1125.60	1138.80	1106.10	1143.30
1968	1204.00	1227.10	1161.60	1277.30

WS^{FAK}

YEAR	1	2	3	4
1956	54.00	58.30	63.80	62.90
1957	56.70	59.70	67.40	62.00
1958	71.60	73.00	78.90	78.70
1959	70.40	73.90	82.10	79.80
1960	71.30	75.80	83.30	79.70
1961	71.00	75.10	83.10	79.90
1962	73.20	77.90	84.30	80.10
1963	73.60	77.20	84.90	83.10
1964	77.50	80.50	89.50	88.70
1965	78.90	84.20	93.90	93.50
1966	84.00	89.00	98.60	96.80
1967	88.50	94.60	100.30	98.00
1968	91.20	96.90	106.30	105.30

WS^{TEX}

10-

YEAR	1	2	3	4
1956	11.80	10.00	9.90	12.20
1957	14.20	13.60	13.80	15.00
1958	11.80	13.00	12.90	18.10
1959	13.40	15.10	14.30	15.00
1960	14.60	15.20	15.60	16.10
1961	15.60	18.50	19.10	22.70
1962	21.00	23.10	22.90	27.30
1963	24.00	26.00	25.00	31.40
1964	27.20	29.60	29.10	31.20
1965	32.80	34.50	31.60	40.30
1966	35.40	35.40	36.70	43.00
1967	33.90	35.00	41.10	40.80
1968	45.60	45.60	46.30	56.00

WS^{OND}

11-

YEAR	1	2	3	4
1956	188.90	193.10	190.80	203.50
1957	205.50	196.10	196.30	207.40
1958	171.60	170.30	169.30	182.80
1959	174.70	186.00	189.20	197.00
1960	188.10	194.60	197.30	200.40
1961	188.00	192.90	195.80	202.30
1962	199.50	203.40	203.70	212.60
1963	209.20	212.50	214.00	224.90
1964	220.10	224.20	224.10	242.30
1965	226.60	235.50	245.70	260.40
1966	246.20	252.90	267.00	276.00
1967	263.70	266.[illegible]0	271.30	282.90
1968	276.80	285.70	297.70	314.60

WS^{WT}

12-

YEAR	1	2	3	4
1956	156.10	161.20	164.40	186.30
1957	164.00	162.60	170.10	182.60
1958	154.10	144.90	148.10	161.50
1959	153.90	155.00	161.00	178.40
1960	165.20	164.90	169.30	177.30
1961	167.70	164.60	168.10	179.00
1962	174.20	174.70	175.70	189.00
1963	184.50	183.60	187.50	202.30
1964	198.10	196.50	204.60	225.60
1965	224.90	225.20	233.70	260.20
1966	238.20	238.60	255.70	273.90
1967	268.50	262.20	277.30	289.20
1968	288.50	284.60	292.90	317.50

WS^{RT}

13.

YEAR	1	2	3	4
1956	225.90	244.90	252.20	278.10
1957	247.10	250.70	256.30	273.70
1958	249.90	248.20	252.70	276.60
1959	253.80	268.90	277.20	302.70
1960	270.70	285.40	290.40	305.80
1961	264.70	283.10	274.60	299.20
1962	273.60	288.90	291.60	316.30
1963	294.20	306.70	311.70	343.40
1964	315.20	326.80	343.20	380.00
1965	341.70	369.80	385.00	437.50
1966	394.30	418.10	435.30	466.90
1967	426.20	451.00	473.60	491.90
1968	477.40	499.90	519.40	555.60

WS^{FIRE}

14-

YEAR	1	2	3	4
1956	77.10	76.40	79.40	90.10
1957	82.60	80.00	82.40	93.10
1958	86.20	83.50	85.30	97.00
1959	88.70	88.10	90.90	103.20
1960	91.70	92.80	96.50	107.00
1961	99.40	100.00	99.00	111.60
1962	100.70	101.60	100.00	112.80
1963	105.60	107.50	107.40	120.60
1964	113.90	115.10	115.00	131.90
1965	120.60	125.60	127.90	140.90
1966	136.80	140.40	148.20	155.70
1967	157.50	153.70	164.70	170.10
1968	175.80	172.80	182.80	192.60

WS^{TCU}

15-

YEAR	1	2	3	4
1956	184,20	185.10	192,00	197.70
1957	189,80	192.50	195,30	201.50
1958	177,90	182.30	188.50	198.30
1959	185,10	200,80	201,60	210.50
1960	193,80	202.70	211,40	211.10
1961	187,00	194.70	202,80	208.50
1962	197,00	202,00	210,00	216.90
1963	203,20	211.70	218,80	227.50
1964	219,10	225,00	233,30	242,60
1965	226,00	242.50	253,70	269.80
1966	245,50	257.70	285,00	286.70
1967	268.20	279.30	294,60	295.00
1968	283.80	294.90	320.50	332.80

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WS^{SER}

16-

YEAR	1	2	3	4
1956	219.50	242.90	247.80	262.40
1957	243.50	250.40	250.20	263.90
1958	247.70	246.40	249.60	264.30
1959	245.30	266.00	275.20	292.50
1960	265.60	277.80	285.10	290.40
1961	269.70	278.50	285.40	303.30
1962	28[illegible].[illegible]0	298.[illegible]0	307.20	326.80
1963	304.10	322.60	333.10	357.20
1964	336.60	352.80	368.70	397.90
1965	354.90	388.70	405.30	450.20
1966	402.90	435.50	464.00	483.70
1967	456.60	482.60	506.60	523.20
1968	504.[illegible]0	529.20	555.90	586.90

WS^{GOV}

17-

YEAR	1	2	3	4
1956	309.10	314.10	312.40	334.40
1957	304.80	317.50	317.70	343.00
1958	353.70	369.00	356.60	382.70
1959	353.00	366.10	356.50	394.40
1960	374.30	400.70	410.20	418.10
1961	422.20	433.90	416.40	438.60
1962	45[illegible].20	452.20	447.60	476.00
1963	492.40	494.30	488.20	516.10
1964	506.30	510.30	509.30	568.10
1965	518.00	559.40	567.10	641.50
1966	577.30	622.90	704.10	690.60
1967	711.50	737.10	645.80	802.60
1968	784.40	827.40	723.10	886.10

WS^{OI}

15-

YEAR	1	2	3	4
1956	3.40	3.50	3.50	3.60
1957	3.40	3.50	3.50	3.60
1958	3.70	3.60	3.80	3.70
1959	3.50	3.50	3.50	3.50
1960	3.70	3.70	3.80	3.80
1961	3.70	3.70	3.80	3.80
1962	3.90	4.00	4.00	4.10
1963	4.10	4.20	4.30	4.40
1964	4.40	4.50	4.50	4.60
1965	4.60	4.70	4.70	5.00
1966	5.20	5.40	5.50	5.90
1967	5.50	6.10	6.00	6.50
1968	6.20	6.20	6.30	6.30

MWS

19-

YEAR	1	2	3	4
1956	2921.30	2906.20	2914.80	3213.60
1957	3044.90	2984.40	2968.60	3081.40
1958	2825.40	2728.40	2740.60	3014.70
1959	2874.10	3062.70	3085.90	3231.90
1960	3164.30	3190.50	3240.20	3241.00
1961	2963.40	3075.30	3075.10	3304.20
1962	3219.80	3325.10	3331.20	3562.70
1963	3481.40	3577.20	3596.70	3885.60
1964	3400.90	3887.30	3960.20	4238.60
1965	4077.40	4347.10	4385.20	4934.40
1966	4580.50	4774.00	5034.40	5183.90
1967	4961.90	5040.20	5091.40	5328.60
1968	5485.50	5568.30	5543.80	6087.40

OLI

20

YEAR	1	2	3	4
1956	123.30	122.60	122.00	123.10
1957	135.30	134.60	133.90	134.20
1958	138.40	137.00	137.00	137.60
1959	155.00	156.30	156.30	156.40
1960	167.80	167.10	166.40	166.70
1961	163.90	164.60	164.30	165.20
1962	185.20	185.50	185.20	186.10
1963	203.30	203.50	203.20	204.00
1964	234.60	234.70	234.70	234.80
1965	276.90	277.30	276.80	278.00
1966	311.50	311.50	310.50	312.50
1967	322.80	322.00	320.20	322.00
1968	369.70	369.70	369.80	369.80

PROPF

22=

YEAR	1	2	3	4
1956	64.70	64.70	64.80	64.80
1957	56.00	56.00	56.00	56.00
1958	74.70	74.70	74.80	74.80
1959	57.20	57.20	57.30	57.30
1960	59.20	59.20	59.30	59.30
1961	74.00	74.00	74.00	74.00
1962	64.20	64.20	64.30	64.30
1963	67.20	67.20	67.30	67.30
1964	70.50	70.50	70.50	70.50
1965	65.50	65.50	65.50	65.50
1966	83.20	83.20	83.30	83.30
1967	68.00	68.00	68.00	68.00
1968	70.20	70.20	70.30	70.30

PROPNF

23.

YEAR	1	2	3	4
1956	302.60	366.90	354.00	396.50
1957	335.00	363.30	364.90	398.80
1958	317.00	344.50	351.30	396.20
1959	341.30	377.00	387.30	398.40
1960	335.40	358.10	368.10	398.40
1961	323.40	361.90	370.70	401.00
1962	345.20	372.80	378.90	413.10
1963	354.40	382.90	399.90	428.80
1964	393.70	424.70	441.20	495.40
1965	424.50	478.90	498.40	555.20
1966	460.70	510.30	528.90	566.10
1967	472.30	529.70	524.60	608.40
1968	488.80	549.60	560.30	628.30

PROPY

24.

YEAR	1	2	3	4
1956	420.30	438.00	470.20	504.50
1957	469.30	478.00	483.30	499.50
1958	461.80	476.60	481.30	500.30
1959	451.50	507.50	535.30	562.90
1960	535.10	536.40	553.10	573.40
1961	528.80	539.30	582.00	624.90
1962	575.00	592.70	592.30	662.00
1963	639.70	664.20	650.10	729.00
1964	695.50	722.60	708.80	792.10
1965	794.00	814.50	807.80	921.70
1966	850.00	877.90	899.60	969.50
1967	928.10	954.60	941.10	1005.20
1968	1007.40	1068.50	1072.50	1129.60

TRANS

25-

YEAR	1	2	3	4
1956	191,70	209.40	222,80	208.10
1957	217,20	226.40	234.10	248.30
1958	307,40	349.70	324.10	292.80
1959	291,50	276,50	279,80	300.20
1960	285,50	290.50	305,40	310.60
1961	373,70	360.70	344,40	339.20
1962	351,10	336.30	343,40	335.20
1963	356,60	353.50	348.10	345.80
1964	362,70	357.60	360,10	355.60
1965	371,50	369.70	412,80	394.00
1966	429,60	430.40	445.20	422.80
1967	502,30	520.10	521,70	521.90
1968	553,50	576,50	594,00	584.00

EECFSS

30-

YEAR	1	2	3	4
1956	52.30	47.20	46.30	32.00
1957	63.70	58.90	46.50	30.50
1958	54.30	50.60	43.70	29.70
1959	65.00	68.50	57.10	36.90
1960	86.20	84.60	67.70	41.60
1961	78.50	81.20	65.60	44.90
1962	91.00	91.60	69.50	41.50
1963	111.90	113.20	81.30	47.60
1964	121.70	120.20	84.10	48.70
1965	132.90	134.20	88.90	54.20
1966	172.10	180.30	155.70	107.70
1967	191.60	182.10	174.30	110.90
1968	216.20	229.10	186.80	141.70

SECFSS

34-

YEAR	1	2	3	4
1956	5.30	5.30	5.40	5.40
1957	6.00	6.00	6.00	6.10
1958	5.60	5.70	5.70	5.70
1959	7.00	7.00	7.00	7.00
1960	8.10	8.10	8.20	8.20
1961	8.00	8.00	8.00	8.00
1962	8.40	8.40	8.50	8.50
1963	9.70	9.70	9.70	9.80
1964	9.30	9.40	9.40	9.40
1965	10.20	10.20	10.30	10.30
1966	13.60	13.60	13.70	13.70
1967	15.20	15.30	15.30	15.30
1968	17.30	17.40	17.40	17.40

TECFSS

33-

YEAR	1	2	3	4
1956	57.60	52.50	51.70	37.40
1957	66.70	64.90	52.50	36.60
1958	59.90	56.30	49.40	35.40
1959	72.60	75.50	64.10	43.90
1960	94.30	92.70	75.90	49.80
1961	86.30	89.20	73.60	52.90
1962	99.40	100.00	78.00	50.00
1963	121.60	122.90	91.00	57.40
1964	131.00	129.60	93.50	58.10
1965	143.10	144.40	99.20	64.50
1966	135.70	193.90	169.40	121.40
1967	206.80	197.40	189.60	126.20
1968	233.50	246.50	204.20	159.10

CFSI

26-

YEAR	1	2	3	4
1956	73,10	68,70	65,00	53,10
1957	84,70	83,60	67,20	53,60
1958	82,00	78,70	67,90	55,40
1959	92,20	97,00	81,30	63,50
1960	113,70	112,50	93,60	69,20
1961	109,30	114,10	93,10	75,50
1962	122,30	124,10	97,00	72,50
1963	145,70	149,90	111,60	80,80
1964	158,60	158,90	115,20	84,10
1965	17[illegible],40	174,70	123,90	92,00
1966	216,90	227,40	199,10	156,60
1967	254,20	246,70	232,30	171,80
1968	278,30	295,70	246,50	206,80

MNWS

27.

YEAR	1	2	3	4
1956	1029.50	1132.90	1168.80	1243.90
1957	1128.10	1174.70	1205.00	1283.20
1958	1217.30	1303.80	1300.60	1346.30
1959	1204.30	1277.50	1334.70	1411.70
1960	1269.30	1296.80	1358.70	1439.20
1961	1354.50	1386.40	1442.30	1528.80
1962	1396.40	1427.40	1467.10	1588.20
1963	1475.50	1521.40	1557.00	1694.10
1964	1598.20	1651.20	1700.10	1864.30
1965	1762.60	1831.20	1937.40	2122.40
1966	1918.10	1985.90	2068.40	2197.60
1967	2039.30	2147.70	2143.30	2353.70
1968	2211.60	2338.80	2420.40	2575.20

MPI

28-

YEAR	1	2	3	4
1956	3950.80	4039.10	4082.80	4457.50
1957	4173.00	4159.10	4173.60	4364.60
1958	4043.70	4032.20	4041.20	4361.00
1959	4078.40	4340.20	4420.60	4643.60
1960	4433.60	4489.30	4598.90	4680.20
1961	4317.90	4461.70	4517.40	4833.00
1962	4618.20	4752.50	4798.30	5150.90
1963	4956.90	5098.60	5153.70	5579.70
1964	5399.10	5538.50	5660.30	6102.90
1965	5839.40	6178.30	6322.60	7056.80
1966	6498.60	6759.90	7102.80	7381.50
1967	7001.20	7187.90	7234.70	7682.30
1968	7697.10	7907.10	7964.20	8662.60

EMP[371]

31-

YEAR	1	2	3	4
1956	467.20	406.60	351.30	421.70
1957	432.40	396.10	345.90	376.20
1958	332.70	281.30	260.20	279.70
1959	314.10	310.50	295.20	293.90
1960	337.[illegible]0	309.40	285.00	313.30
1961	254.40	276.40	255.90	287.00
1962	298.30	301.00	282.60	315.00
1963	315.90	316.30	300.40	300.60
1964	333.50	337.50	327.80	317.90
1965	363.20	368.70	338.20	386.60
1966	389.70	388.10	353.00	395.90
1967	379.90	368.20	327.30	367.40
1968	38[illegible].20	380.20	372.40	396.00

EMP^{WS}

107.

YEAR	1	2	3	4
1956	1.21	1.21	1.21	1.21
1957	1.20	1.20	1.20	1.20
1958	1.19	1.19	1.19	1.19
1959	1.19	1.19	1.19	1.19
1960	1.19	1.19	1.19	1.19
1961	1.21	1.21	1.21	1.21
1962	1.22	1.22	1.22	1.22
1963	1.21	1.21	1.21	1.21
1964	1.22	1.22	1.22	1.22
1965	1.23	1.23	1.23	1.23
1966	1.23	1.23	1.23	1.23
1967	1.23	1.23	1.23	1.23
1968	1.23	1.23	1.23	1.23

USAP

32=

YEAR	1	2	3	4
1956	1742.90	1449.70	1042.20	1567.10
1957	179[illegible].60	1580.30	1303.90	1440.70
1958	1238.70	1003.70	631.90	1369.80
1959	1600.40	1683.70	1052.70	1257.00
1960	2002.20	1807.30	1147.60	1739.00
1961	1188.20	1548.60	949.30	1830.20
1962	1766.80	1854.20	1254.90	2059.30
1963	1935.80	2095.20	1316.20	2290.00
1964	2145.20	2290.40	1350.90	1959.00
1965	2561.90	2599.80	1547.50	2626.00
1966	2495.20	2426.60	1256.80	2426.00
1967	1673.30	2171.70	1249.30	2118.30
1968	2321.60	2522.80	1480.60	2524.60

GNP

60-

YEAR	1	2	3	4
1956	443,60	445,60	444,50	450,30
1957	453,40	453,20	455,20	448,20
1958	437,50	439,50	450,70	461,60
1959	468,60	479,90	475,00	480,40
1960	49[illegible],20	489,70	487,30	483,70
1961	482,60	492,80	501,50	511,70
1962	519,50	527,70	533,40	538,30
1963	541,20	546,00	554,70	562,10
1964	569,70	578,10	585,00	588,50
1965	60[illegible],50	609,70	620,70	634,40
1966	645,40	649,30	654,80	661,10
1967	660,70	664,70	672,00	681,80
1968	693,30	705,80	712,80	718,50

MFGNO$_{-1}$

61-

YEAR	1	2	3	4
1956	86.70	84.70	85.10	83.20
1957	87.30	87.70	83.70	79.90
1958	79.40	76.10	78.70	80.90
1959	87.20	93.50	95.70	88.40
1960	90.50	91.00	91.50	89.60
1961	89.20	87.80	93.90	93.00
1962	98.00	100.50	100.50	96.70
1963	100.30	104.60	107.10	102.80
1964	105.80	110.10	115.70	111.90
1965	114.70	120.20	124.40	120.90
1966	126.70	135.20	138.80	134.20
1967	134.00	131.60	138.30	134.10
1968	138.70	147.60	152.40	148.80

MFGDNO$_{-1}$

62=

YEAR	1	2	3	4
1956	48.50	46.60	46.50	44.40
1957	46.90	46.90	43.40	39.50
1958	39.50	36.30	38.10	39.10
1959	44.60	50.10	51.10	44.20
1960	46.00	46.60	47.00	44.80
1961	44.30	42.60	48.20	46.50
1962	50.40	52.70	52.30	48.30
1963	51.70	55.50	56.90	52.50
1964	54.60	58.40	62.00	57.70
1965	59.50	64.70	66.30	62.60
1966	67.20	73.70	75.30	70.60
1967	70.20	67.80	72.60	67.90
1968	72.20	83.20	84.20	79.30

K^{37}_{-1}

73.

YEAR	1	2	3	4
1956	6782.90	6941.30	7099.80	7258.20
1957	7363.70	7469.30	7574.90	7680.50
1958	7749.60	7818.80	7888.00	7957.20
1959	8034.90	8112.70	8190.50	8268.20
1960	8363.00	8457.80	8552.70	8647.50
1961	8728.50	8809.50	8890.60	8971.60
1962	9051.10	9130.50	9210.00	9289.40
1963	9397.80	9506.20	9614.70	9723.10
1964	9856.50	9989.90	10123.40	10256.80
1965	10449.30	10641.90	10834.50	11027.00
1966	11225.10	11429.20	11630.40	11831.50
1967	12086.00	12410.00	12714.00	13059.00
1968	13332.00	13638.00	13951.00	14321.00

K^{MFG}

80-

YEAR	1	2	3	4
1956	2491.40	2574.90	2658.40	2741.90
1957	2825.40	2867.40	2909.50	2951.60
1958	2993.60	3009.90	3026.30	3042.70
1959	3059.10	3084.50	3110.00	3135.50
1960	3160.90	3190.70	3220.60	3250.50
1961	3280.40	3304.20	3328.00	3351.90
1962	3375.70	3400.00	3424.40	3448.80
1963	3473.10	3515.10	3557.20	3599.30
1964	3641.40	3700.70	3760.10	3819.50
1965	3878.80	3965.20	4051.70	4138.20
1966	4224.60	4311.90	4399.20	4486.60
1967	4573.90	4704.00	4854.00	4994.00
1968	5154.30	5264.00	5394.00	5524.00

POP$_{-1}$

57.

YEAR	1	2	3	4
1956	7379.00	7423.00	7467.00	7494.00
1957	7521.00	7545.00	7569.00	7594.00
1958	7620.00	7643.00	7667.00	7693.00
1959	7719.00	7743.00	7767.00	7784.00
1960	7802.00	7817.00	7833.00	7846.00
1961	7860.00	7872.00	7885.00	7895.00
1962	7906.00	7914.00	7923.00	7953.00
1963	7984.00	8010.00	8036.00	8069.00
1964	8102.00	8131.00	8161.00	8204.00
1965	8248.00	8291.00	8334.00	8374.00
1966	8415.00	8455.00	8496.00	8524.00
1967	8552.00	8580.00	8608.00	8625.00
1968	8642.00	8658.00	8673.00	8699.00

POP^{65+}_{-1}

58.

YEAR	1	2	3	4
1956	572.00	577.00	583.00	586.00
1957	590.00	594.00	598.00	601.00
1958	605.00	609.00	613.00	617.00
1959	621.00	625.00	629.00	632.00
1960	635.00	638.00	642.00	645.00
1961	649.00	653.00	657.00	659.00
1962	662.00	665.00	668.00	670.00
1963	673.00	675.00	678.00	681.00
1964	684.00	687.00	690.00	693.00
1965	696.00	699.00	702.00	704.00
1966	707.00	710.00	713.00	716.00
1967	719.00	722.00	726.00	733.00
1968	730.00	732.00	734.00	738.00

AWH^{371}

96-

YEAR	1	2	3	4
1956	39.10	38.20	40.40	43.70
1957	45.60	38.70	39.10	39.80
1958	37.60	38.50	38.60	40.70
1959	43.40	41.90	40.90	39.60
1960	42.90	40.20	39.60	41.10
1961	37.80	40.20	35.30	43.90
1962	42.90	42.80	42.60	45.40
1963	43.10	43.40	42.80	46.10
1964	43.30	44.80	44.30	45.70
1965	47.30	46.50	44.00	47.10
1966	44.70	43.[illegible]	42.90	44.10
1967	4[illegible].20	41.30	42.50	42.30
1968	44.50	44.70	43.80	47.70

MUSAHE -8

108-

YEAR	1	2	3	4
1956	7,46	8.88	8.90	9.84
1957	8,28	9,59	9,36	9.73
1958	7,32	7.76	7,43	8.01
1959	6,91	8,32	8,32	8.99
1960	7,89	9,28	8,98	9.53
1961	7,57	8.61	8.65	9.54
1962	8,32	9.50	9,62	10,18
1963	8,25	9.74	10,14	11.09
1964	9,40	11,11	11,54	12.84
1965	10,79	12,81	13,41	14,95
1966	12,77	15,29	15,57	17.00
1967	13,59	15,61	15,40	17.05
1968	14,25	15,86	16,02	17.95

LICMFG

99-

YEAR	1	2	3	4
1956	0.34	0.34	0.34	0.34
1957	0.42	0.42	0.42	0.42
1958	0.59	0.59	0.59	0.59
1959	0.50	0.50	0.50	0.50
1960	0.46	0.46	0.46	0.46
1961	0.52	0.52	0.52	0.52
1962	0.57	0.57	0.57	0.57
1963	0.59	0.59	0.59	0.59
1964	0.77	0.77	0.77	0.77
1965	1.09	1.09	1.09	1.09
1966	1.20	1.20	1.20	1.20
1967	1.27	1.27	1.27	1.27
1968	1.70	1.70	1.70	1.70

MICMFG

100-

YEAR	1	2	3	4
1956	62.40	62.40	62.40	62.40
1957	66.90	66.90	66.90	66.90
1958	71.80	71.80	71.80	71.80
1959	85.80	85.80	85.80	85.80
1960	86.60	86.60	86.60	86.60
1961	95.20	95.20	95.20	95.20
1962	210.60	210.60	210.60	210.60
1963	237.10	237.10	237.10	237.10
1964	257.40	257.40	257.40	257.40
1965	255.80	255.80	255.80	255.80
1966	252.70	252.70	252.70	252.70
1967	252.70	252.70	252.70	252.70
1968	269.90	269.90	269.90	269.90

CPI_m

55-

YEAR	1	2	3	4
1956	93.60	93.80	94.20	94.70
1957	96.30	96.20	96.40	99.30
1958	99.20	99.50	100.10	100.70
1959	103.70	103.80	103.90	103.90
1960	104.30	105.10	106.80	107.10
1961	107.60	112.60	113.00	113.00
1962	113.50	114.60	114.80	114.60
1963	115.30	123.10	123.20	123.40
1964	124.70	124.70	124.60	125.20
1965	127.30	128.20	128.80	128.60
1966	133.30	134.80	137.10	140.20
1967	142.60	143.90	146.90	149.70
1968	153.60	153.50	154.90	158.50

SSR

36-

YEAR	1	2	3	4
1956	0.04	0.04	0.04	0.04
1957	0.05	0.05	0.05	0.05
1958	0.05	0.05	0.05	0.05
1959	0.05	0.05	0.05	0.05
1960	0.06	0.06	0.06	0.06
1961	0.06	0.06	0.06	0.06
1962	0.06	0.06	0.06	0.06
1963	0.07	0.07	0.07	0.07
1964	0.07	0.07	0.07	0.07
1965	0.07	0.07	0.07	0.07
1966	0.08	0.08	0.08	0.08
1967	0.09	0.09	0.09	0.09
1968	0.09	0.09	0.09	0.09

MAXTY

35-

YEAR	1	2	3	4
1956	4200.00	4200.00	4200.00	4200.00
1957	4200.00	4200.00	4200.00	4200.00
1958	4200.00	4200.00	4200.00	4200.00
1959	4800.00	4800.00	4800.00	4800.00
1960	4800.00	4800.00	4800.00	4800.00
1961	4800.00	4800.00	4800.00	4800.00
1962	4800.00	4800.00	4800.00	4800.00
1963	4800.00	4800.00	4800.00	4800.00
1964	4800.00	4800.00	4800.00	4800.00
1965	4800.00	4800.00	4800.00	4800.00
1966	6600.00	6600.00	6600.00	6600.00
1967	6600.00	6600.00	6600.00	6600.00
1968	7800.00	7800.00	7800.00	7800.00

$USCP^{MFG}_{-1}$

81=

YEAR	1	2	3	4
1956	4151.00	3982.00	4246.00	3670.00
1957	4255.00	4099.00	4072.00	3737.00
1958	3539.00	2472.00	2835.00	3315.00
1959	4529.00	3281.00	4862.00	3825.00
1960	3332.00	3992.00	4081.00	3612.00
1961	3513.00	2900.00	3965.00	3837.00
1962	4509.00	4004.00	4651.00	4227.00
1963	4837.00	4024.00	5213.00	4785.00
1964	5461.00	5121.00	6121.00	5670.00
1965	6299.00	6232.00	7215.00	6590.00
1966	7484.00	7229.00	8375.00	7400.00
1967	7933.00	6748.00	7596.00	6718.00
1968	7946.00	7430.00	8286.00	7635.00

ML_{-1}

84=

YEAR	1	2	3	4
1956	8551.90	8142.20	8280.80	8526.40
1957	8729.80	8600.70	8585.10	8847.90
1958	9444.[illegible]0	9611.30	9912.30	9038.20
1959	9386.20	9136.70	9329.30	9504.60
1960	9637.90	9886.70	10051.30	10105.40
1961	10351.[illegible]0	10218.70	10429.50	10560.50
1962	11146.40	11008.60	11531.30	11767.20
1963	12443.50	12285.90	12763.60	13190.90
1964	13435.10	13723.90	14218.80	14589.60
1965	15222.50	15394.70	15738.60	16405.10
1966	16928.00	16862.30	17233.40	17837.30
1967	18292.10	18614.90	18951.50	19638.80
1968	20427.40	20487.80	20684.20	21471.80

UEMP

106-

YEAR	1	2	3	4
1956	2.52	2.46	2.40	2.52
1957	2.49	2.45	2.40	2.43
1958	2.26	2.17	2.16	2.23
1959	2.24	2.31	2.31	2.33
1960	2.34	2.36	2.34	2.35
1961	2.17	2.25	2.25	2.31
1962	2.26	2.34	2.34	2.40
1963	2.33	2.41	2.42	2.49
1964	2.45	2.51	2.54	2.57
1965	2.59	2.69	2.69	2.79
1966	2.80	2.85	2.84	2.94
1967	2.88	2.90	2.86	2.96
1968	2.95	2.99	3.01	3.09

OAS-1

94-

YEAR	1	2	3	4
1956	63.30	60.60	62.90	69.00
1957	72.00	77.[illegible]0	83.80	90.10
1958	93.80	93.40	98.10	101.80
1959	106.20	113.30	117.00	123.90
1960	126.60	125.20	128.60	134.10
1961	136.90	139.70	144.00	152.20
1962	157.80	160.20	164.40	170.10
1963	174.20	171.50	174.90	178.70
1964	18[illegible].70	179.70	182.00	186.10
1965	187.50	186.20	189.30	230.60
1966	216.50	218.[illegible]0	224.40	227.30
1967	233.60	232.10	237.60	238.80
1968	241.70	251.90	278.10	280.00

MED$_{-1}$

95-

YEAR	1	2	3	4
1956	0.80	0.80	0.90	1.00
1957	1.00	1.10	1.10	1.80
1958	2.50	1.90	2.10	2.20
1959	2.30	2.40	2.60	2.30
1960	2.30	2.40	2.40	3.20
1961	4.10	6.20	7.50	8.20
1962	8.10	8.60	9.00	9.10
1963	8.60	8.60	9.70	8.00
1964	9.00	10.20	10.60	10.20
1965	10.60	11.20	13.70	12.90
1966	13.10	20.30	25.40	20.70
1967	12.30	22.50	36.20	36.80
1968	36.80	41.90	43.40	46.30

w^{371}

47-

YEAR	1	2	3	4
1956	2.00	2.00	2.05	2.05
1957	2.05	2.05	2.10	2.10
1958	2.10	2.10	2.20	2.30
1959	2.30	2.30	2.40	2.40
1960	2.40	2.40	2.40	2.45
1961	2.45	2.45	2.50	2.50
1962	2.60	2.60	2.60	2.70
1963	2.70	2.70	2.75	2.75
1964	2.75	2.75	2.85	2.85
1965	2.85	2.85	2.85	2.90
1966	2.90	2.90	2.90	3.00
1967	3.23	3.23	3.23	3.43
1968	3.43	3.43	3.43	3.62

w^{MIN}

48-

YEAR	1	2	3	4
1956	2.47	2.47	2.58	2.58
1957	2.61	2.61	2.71	2.71
1958	2.76	2.76	2.80	2.80
1959	2.81	2.81	2.81	2.81
1960	2.81	2.81	2.81	2.81
1961	2.86	2.86	2.86	2.86
1962	2.96	2.96	2.96	2.96
1963	2.96	2.96	2.96	2.96
1964	2.96	2.96	2.96	2.96
1965	2.96	2.96	2.96	3.26
1966	3.26	3.26	3.26	3.26
1967	3.26	3.26	3.35	3.35
1968	3.35	3.35	3.61	3.61

w^{CC}

49-

YEAR	1	2	3	4
1956	2.20	2.33	2.33	2.33
1957	2.33	2.45	2.45	2.45
1958	2.45	2.53	2.53	2.53
1959	2.53	2.63	2.63	2.63
1960	2.63	2.68	2.68	2.73
1961	2.73	2.83	2.83	2.83
1962	2.83	2.93	2.93	2.93
1963	2.93	2.93	3.03	3.05
1964	3.05	3.15	3.15	3.15
1965	3.15	3.20	3.20	3.20
1966	3.20	3.40	3.40	3.40
1967	3.35	3.55	3.55	3.55
1968	3.81	4.01	4.01	4.01