

UNIVERSITY OF CALIFORNIA
RIVERSIDE

Major Element Chemistry and Mineralogy in well Fee #5,
in the Salton Sea Geothermal Field, California.

A thesis submitted in partial satisfaction
of the requirements for the degree of

Master of Science

in

Geological Sciences

by

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December, 1987

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ABSTRACT OF THE THESIS

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This study provides important new information necessary to model the migration of major elements in the Salton Sea Geothermal System. The SSGS is an active geothermal system which is located in a sediment filled rift basin formed by the northward extension of the Gulf of California structural system. Temperatures in excess of 300°C, concentrated brines in excess of 250,000 ppm TDS, and stratigraphy similar to salt deposits make the SSGS suitable for a natural analog for a near-field high-level nuclear waste repository in salt. Present studies of this system funded by the Office of Nuclear Waste Isolation are focusing on information which can be used to validate geochemical computer codes developed to model behavior in the near-field

of a high-level nuclear waste repository in salt. Information regarding the chemical and mineralogical environment in which migration of natural radionuclides, or elements which proxy for those in nuclear waste, occurs is presented in this study.

Sandstone and shale samples from well Fee #5 in the SSGS were selected from drill cuttings at 200 foot (61 m) intervals, and were analyzed by x-ray diffraction for and x-ray fluorescence techniques for major minerals and elements respectively. These data are plotted to display the vertical distribution with depth of minerals and major elements. Apparent changes in these distributions occur which differ from the expected sedimentary variations and appear to be due to hydrothermal reactions. These interpretations are confirmed by reinterpretation of previous petrographic studies.

The interrelationship between mineralogy and rock chemistry is demonstrated by cross plotting and comparing mineralogical and elemental distribution. This method allows for qualitative interpretations about the controlling factors for elemental migration. Probable chemical reactions which produce the observed relationships were then ascertained. These reactions are responsible for two authigenic mineralogical zones in and adjacent to well Fee

#5. The upper zone is identified by the presence of kaolinite, montmorillonite, and abundant ankerite and dolomite. Below this zone there is a transition to a mineralogical zone dominated by chlorite, illite, and abundant calcite. This transition takes place beginning at 188°C (4,000 feet, 1220 m) in sandstones and at 218°C (5,000 feet, 1525 m) in shales. The higher permeability in the sandstones as compared to the shales permits a greater degree of water to rock interaction in the sandstones, therefore reactions take place more extensively and at shallower depths in the sandstones. Elements which are considered mobile due to the existence of aqueous species in these reactions include Si, Mg, Fe, Ca, K, Na, and CO₂(g). Ti and Mn are believed to be mobile as substitutes for Fe. Aluminum is considered to be immobile.

TABLE OF CONTENTS

<u>Page</u>	
	Acknowledgements iii
	Abstract of the Thesis iv
	Introduction 1
	The Salton Sea Geothermal System 2
	Location and Geologic Setting 2
	The SSGS as a Nuclear Waste Analog 4
	Choice of Well Fee #5 5
	Previous Studies of Well Fee #5 8
	Lithology 8
	X-ray Diffraction 10
	Petrographic Analyses of Sandstones 10
	Textural Changes 11
	Optical Mineralogical Variations 12
	Igneous Intrusives 15
	Oxygen and Carbon Isotopic Chemistry 15
	Water Chemistry 17
	Temperature Data 19
	Well Fee #5 Samples 22
	Sample Selection 22
	Grinding Samples 22

TABLE OF CONTENTS (cont.)

X-ray Diffraction Mineralogy	24
Methods	24
Results	25
Quartz	25
Plagioclase	32
Alkali Feldspar	32
Phyllosilicates	33
Carbonates	35
Pyrite	37
Hematite	37
Anhydrite	37
Gypsum	38
Major Element Chemistry	39
Data Collection	39
Data Reduction	40
Results	44
Silicon	44
Aluminum	58
Calcium	65
Magnesium	70
Sodium	81
Potassium	86
Iron	92

TABLE OF CONTENTS (cont.)

Manganese	93
Titanium	96
Phosphorus	97
Volatiles	98
Chemical Migration and Mineral Reactions	102
Discussion and Conclusions	111
References	114
Appendix A	118
Appendix B	126