the previously reported deuterium content of the brines and local surficial waters.

The most critical geochemical questions concern the mechanism for brine concentration, the origin of the Cl ion, and the surprisingly high Ca/Mg, K/Na, and Ca/K ratios of the brine. The arkosic sedimentary fill of the Imperial Valley graben contains ample material to provide by solution every chemical in the brines except for the Cl ion. Models of the brine column *versus* original material contained in the encompassing rock column suggest a deficiency of Cl ion. A high degree of interchange between the host rock and the thermal waters exists, as evidence by previously reported data (^{18}O and B content) and the similarity of the Rb/K ratios of the brines to those of arkosic materials.

The Cl ion must be either juvenile in origin, or a result of the concentration of meteoric interstitial water of the sedimentary fill, or derived from Cl absorbed onto silicate surfaces. The similarity of the Br/Cl ratio of the brines to local meteoric surface and ground waters, and its complete dissimilarity to those of Cl evaporites, suggest that the brines are dominantly interstitial meteoric water concentrated manyfold. Doubtless some of these brine halogens also were obtained by desorption of absorbed material at high temperatures.

Hyperfiltration of relatively dilute hydrothermal solutions through electrostatic semi-permeable membranes composed of abundant montmorillonitic and illitic clays in the sedimentary fill provides the best mechansim for concentrating the brines within the proposed thermal convection cell and of affecting the relative composition of the brine and the relatively dilute waters underlying the thermal anomaly. In particular, this mechanism best explains the Ca/Na ratios of the brine; the relative abundance of Sr, Ca, and Mg within the brines possibly may be a result of this mechanism; the increase of HCO_3/Cl, F/Cl, and B/Cl ratios in the dilute overlying waters, which would be effluent to the proposed membrane system, probably is a result of such hyperfiltration. High-temperature metastable equilibria between the thermal brine and its enclosing rocks strongly affect the specific composition of the brine. Such reactions probably control completely the trace-element metal content of the brines. The relative abundance of the alkali-metals appears to be strongly influenced by such rock-water reactions as well as by relative hyperfiltration. Experimental investigations are needed to understand further the origin of these waters.

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EFFECT OF E.S.C.P. ON GEOLOGIC PROFESSIONS

Earth science is a popular and effective medium for teaching science in secondary schools. With the finalization of the E.S.C.P. materials in 1967, thousands of secondary schools will be added to the thousands that already have adopted earth science. What will this trend mean to the geologic professions?

The science of the earth deals with the materials of the planet and the processes which bring about changes. Youngsters who learn their basic science principles by studying earth materials and processes will develop an appreciation for the problems which man faces in coping with his environment and in finding and extracting useful materials from the earth's crust. Laboratory investigations and field experiences will put geology in a science framework, divorcing it from rock-collecting and dinosaur-naming. Universities can expect greater numbers of students with geologically oriented interests and a greater depth of appreciation for the science of geology.

A secondary school earth science course such as E.S.C.P. will not teach well logging, for example, but will prepare the student to understand why someone might want to detect differences in rock layers with depth and what these differences might mean. Principles are stressed; technical aspects are not. The effect that E.S.C.P. will have in changing the image of the geologic professions and in interesting more youngsters in studying various aspects of man's environment may be a tidal wave.

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PALEOZOIC AGE DETERMINATIONS

The integration of classical paleontological methods and "absolute" radiometric methods for the establishment of the time parameter for geologic processes during the Paleozoic Era has been barely initiated. Sufficient preliminary radiometric data have been obtained on stratigraphically assignable materials to give approximate time interval assignments to the Paleozoic Era and its constituent periods. Yet there are fewer than half a dozen correlation points which begin to possess the documentation from both approaches that is necessary and feasible.

For each of the various Paleozoic systems it is a reasonable estimate that 20 ± 10 resolvable faunal zones can be distinguished consistently. Accepting present estimates for the duration of the Paleozoic in absolute time, this could provide the corresponding average resolving power of $\pm$ 2-3 m.y. if the faunal zones were successfully calibrated. Utilizing optimal geological materials and adequate sampling and analytical procedures, it should be possible to establish radiometric ages with precisions of $\pm$ 5 to $\pm$ 2 m.y. from the beginning to the end of the Paleozoic. Discrepancies in radioactive decay constants can be normalized to $\lambda\ U^{238}$, adequately, for such purposes. Thus the potential resolving power of the radiometric and paleontologic methods is comparable.

A successful effort at cross-calibration could provide the basis for the determination of the important time constants for the great host of significant geologic processes ranging from faunal evolution to orogeny recorded for the Paleozoic interval. The keys to such an effort are: (1) a careful geologic search for the definitive sampling sites; (2) realistic evaluation of stratigraphic assignments using as many independent faunal elements as possible; and (3) persistent application of several radiometric methods to materials whose geologic context at the sample site has been established by careful mapping and petrologic study. A preliminary evaluation suggests that numerous sites containing intraformational tuffs, intercalated volcanic rocks, and stratigraphically assigned plutonic rocks exist in North America and Europe. A coordinated interlaboratory effort should be a major geological objective in the next 5 years.

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