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tests using NaCl samples have indicated that the method will yield satisfactory measurements of elastic constants with an accuracy of the order of 1% at pressures up to 100 kilobars. At pressures higher than 100 kilobars alcohol vitrifies and true hydrostatic environment becomes impossible.

PROPERTIES OF MINERALS UP TO 300 KILOBARS AND 2000°C USING THE DIAMOND ANVIL CELL AND LASER HEATING

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Laser heating in a diamond anvil press is capable of achieving constant temperatures up to 2000°C at pressures up to 300 kilobars. This capability enables us to study phase transformations in silicates. We have demonstrated that olivines, $(Fe,Mg)SiO_4$, and the orthopyroxenes, $(Fe,Mg)SiO_3$, undergo various phase transitions but ultimately decompose into an isochemical mixture of simple oxides, (Fe,Mg)O and $SiO_2$ (stishovite) at pressures greater than 250 kilobars. We believe, therefore, that an oxide mixture is the most probable constituent of the Earth's lower mantle.

An X-ray beam directed perpendicular to the loading axis in a specially designed diamond anvil cell is diffracted by a polycrystalline sample so as to produce complete diffraction cones. The d-spacings of the atomic planes depend on the orientation of the planes with respect to the loading axis. The diffraction pattern can then be used to measure directional elastic strain and to calculate the strength of the sample as a function of pressure. The strength of MgO has been shown to increase to ∿40 kilobars at a pressure of ∿80 kilobars and remain there until 260 kilobars, our highest pressure.

The effect of compression on the radioactive decay rate of $^{22}$Na has been measured by counting a $^{22}$NaCl sample while under pressure in a diamond anvil cell. The ratio of the relative intensities of the 511 and 1274 keV gamma rays has been measured as a function of confining pressure. Preliminary results indicate that the increase in the decay rate $(\Delta\lambda/\lambda_o)$ is 0.005 ± 0.005 at 210 kilobars.

GEOCHEMICAL VARIATIONS IN THE COPPER CANYON PORPHYRY COPPER DEPOSITS, LANDER COUNTY, NEVADA

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The Copper Canyon Cu-Au-Ag deposits include two hypogene ore bodies developed primarily in late Paleozoic rocks adjacent to a 38-m.y. old potassic-altered granodiorite. Widespread, but subeconomic concentrations of sulfide minerals as fracture and cavity fillings in skarn apparently preceded the final intrusion of the granodiorite. The east ore body probably formed after the granodiorite reached its present level. δD values of water from fluid inclusions in quartz ranged from -101.5 to -75.6 per mil. Water calculated to be in equilibrium with the quartz using fluid-inclusion filling temperatures ranged in $\delta^{18}O$ from +3.1 to +10.9 per mil. Filling temperatures of the fluid inclusions ranged from 270° to 385°C. Temperatures of the fluid-inclusions calculated utilizing the Na-K-Ca geothermometer of Fournier and others (1971) range from 275° to 450°C and are in good agreement with filling temperatures.

The calculated δD values of water in equilibrium with the biotites are in the interval -99.3 to -76.4 per mil; the calculated $\delta^{18}O$ values from +5.8 to +10.4 per mil. The secondary biotites are depleted in both $^{18}O$ and D, and the temperatures calculated from coexisting quartz-biotite pairs show a temperature gradient from 790° to 382° from the primary to the secondary biotites. These data suggest that fluids associated with potassic alteration at Copper Canyon were most likely composed of magmatic water mixed with significant amounts of meteoric water.





MICROFRACTURES IN ROCKS FROM TWO GEOTHERMAL AREAS

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The study of microfractures can be a significant tool for determining the histories and physical properties characteristic of geothermal systems. Cores of detrital sedimentary rocks from a 600 m well in the Dunes area, California and a 450 m well in the Raft River area, Idaho show diagenesis superimposed on episodic fracturing and fracture sealing. The petrographic microscope, used with 100μ thick 'crack sections', together with the scanning electron microscope allow the determination of fracture morphologies, mineralogies, and spatial relationships. Fracturing events can be dated relatively by cutting relationships and progressive changes in fracture mineralogy. Vertical variations in fracture mineralogies as well as impermeable shale beds indicate that lateral fluid movement probably predominates in these two geothermal areas. Open, sealed, and healed fractures can often be recognized in electron microprobe analysis as sites of local chemical anomalies.

Fracture porosity can be determined by its effect on rock compressibility. The fracture porosities measured on several cores are less than 0.1%. This low value indicates that fractures are effectively sealed or that fracturing is confined to the large fractures visible within the samples. Sealing and low fracture porosity imply that only the most recently formed fractures are open to fluids. Therefore, areas of recent fracturing will have significantly different transport properties.

UTILIZATION OF SKYLAB S192 SATELLITE IMAGERY FOR GEOLOGICAL INVESTIGATIONS

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Examination of two different scenes from the thirteen channel multispectral scanner (MSS) emphasizes the significance