Tectonophysics

Thermal Structure and Evolution of the Earth (Archean) (HI)
Monday 0830 h
Frank Richter (Univ. of California, Presiding)

T1 THERMAL HISTORY OF THE EARTH: ONE GEOLOGIST’S VIEW
Kevin Burke (Department of Geological Sciences, Stanford University, New York at Albany, Albany, N.Y. 12222)

Archean and Proterozoic greenschist belts closely resemble in structure and rock type Phanerzoic Island arcs and Phanerzoic and Precambrian ophiolites. The close resemblance between these two environments is interpreted as indicating that the subduction processes of the Wilson cycle of the opening and closing of oceans and subduction of plates for key plate-tectonic processes were active during the first half of eons. Although we can only speculate about the later Precambrian, it is possible that the characters of greenschist belts are that they contain ultramafic xenoliths and that they occur more closely spaced than later subureau zones. These characters are interpreted to the earth’s being hotter 2.5 Ga ago. Ultra-thick sequences and an absence of shallow water sediments reported from pre-greenstone belts may be more common. Although the world 2.5 Ga ago was hotter than now, basal continental crust (2.0 Ga) did not generally melt and this indicates that the greater heat being generated in the mantle did not escape by conduction through continental crust. Because rocks and structures of greenschist belts indicate that the Wilson cycle was operating in the Archean we suggest that the extra heat escaped by melting and warming more ocean floor than now—that is by more plate tectonics.

T2 THERMAL HISTORY OF THE EARTH: ANOTHER GEOLOGIST’S VIEW
R.B. Bergman (Dept. of Geological and Geophy- sisical Sciences, Princeton University, Princeton, New Jersey 08541)

In the recent past, it has been found that the Archean, one of the geologic eras that can be subdivided into a number of time periods, is characterized by unusual geologic activity. This has been attributed to the fact that the earth's crust was hotter 2.5 Ga ago. However, there is some disagreement about the extent of this activity. Some geologists believe that the Archean was a time of extensive volcanic activity, while others suggest that it was a time of widespread metamorphism. The debate continues, and further research is needed to fully understand the thermal history of the Earth.

T4 THE EVOLUTION OF PRECAMBRIAN MAMMAMETHEM
Jeffery A. Crumpton (Dept. Geological Sciences, University of California, Berkeley, CA 94720)

A self-consistent set of Precambrian P-T estimates has been compiled by comparing published descriptions of metamorphic assemblages to currently available phase-stability data. Precambrian metamorphic assemblages are found to be the product of thermal gradients that have decreased through time. A second arc sequel, illustrated by the mean depth of greenschist in Phanerzoic belts, show that older belts tend to be less deeply eroded than youngerArg. Geochronol. Geol. (Rochester, N.Y.) 31 1975 103 103 10 1

T5 Pb EVOLUTION IN THE MANTLE
M. Tatsumo (U.S. Geological Survey, MS 636, Box 25088, Denver, Colo. 80225)

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The solid/solid distribution coefficients of Pb for most basaltic minerals appear to be about 10 times the values for 206/204 ratio in the mantle. Both 207/206 and 206/204 ratios in basaltic lavas have been measured on a number of 207/206 values ranging from 0.27 to 0.28 and a number of 206/204 values ranging from 0.70 to 0.71. The solid/solid distribution coefficients are higher in the mantle than in the crust, suggesting that Pb is added to the mantle during subduction. The Pb evolution in the mantle is controlled by the balance between Pb added during subduction and Pb lost during mantle melting.

T6 MANTLE DEPLETION AND THE AGE OF THE CRUST
D. St. Paul (Department of Earth and Space Sciences, University of California, Los Angeles, CA 90024)

Transport equations describing relative radiogenic isotopic loss in the mantle due to accumulation of radiogenic isotopes in the crust have been developed. The age of the crust is a critical parameter in these equations, as it affects the amount of radiogenic isotopes that can be added to the mantle. The age of the crust has been estimated to be between 3.5 and 4.5 billion years, with a recent estimate of 3.5 billion years. The age of the crust is important in understanding the history of the Earth and its evolution.