ECLOGITE NODULES FROM KIMBERLITE PIPES OF THE COLORADO PLATEAU - SAMPLES OF SUBDUCTED FRANCISCAN-TYPE OCEANIC LITHOSPHERE.

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This paper interprets lawsonite-bearing eclogite xenoliths from kimberlite pipes on the East Colorado plateau as fragments of Mesozoic Franciscan-type oceanic crust which was subducted beneath the North American continent and returned to the earth's surface via the kimberlite pipes. The basis for this interpretation will be presented in four parts:

1) The eclogite xenoliths do not resemble eclogites normally found in kimberlites (Group A of Coleman et al., 1965) but eclogites associated with glaucophane schists (Group C). Their mineral assemblage is typical of low-temperature eclogites and consists of pyropic almandine, chloromelanitic clinopyroxene, phengite, rutile, $\pm$ pyrite, $\pm$ lawsonite. Distribution coefficients of Fe and Mg between garnet and clinopyroxene are low and overlap with those of Group C eclogites. The xenoliths have a notably differentiated bulk composition and are nepheline and in part acmite normative. A metamorphic origin is indicated by the rock fabric and igneous relict textures.

2) Most investigators agree that the eclogite xenoliths where derived from beneath the Precambrian gneisses of the Colorado plateau which consists of high-temperature mineral assemblages and yield absolute ages of about 1800 m.y. This implies that rocks with high-temperature mineral assemblages were overlying lawsonite-bearing eclogites at the time of the kimberlite intrusion, 30 m.y. ago. Such incompatibility in mineral assemblages coupled with the evidence for a metamorphic origin of the eclogites can only be explained by a tectonic emplacement of the eclogites beneath the Precambrian of the plateau. Our conclusion that this tectonic emplacement was unrelated to the Precambrian orogenic events in the Colorado Plateau basement but is a Phanerozoic event is based on the fact that lawsonite is unknown from rocks older than 1000 m.y. old and on Rb-Sr isotopic analyses of the xenoliths.

3) There are remarkable similarities between the eclogite xenoliths and Franciscan eclogites including mineral assemblages, physical and chemical properties of constituent minerals, textures, and bulk compositions. Initial Sr^{87}/Sr^{86} ratios of the xenoliths are remarkably high and resemble those of Franciscan basalts.

   Franciscan eclogites have recently been interpreted as remants of subducted oceanic crust. If lithologic correlation cannot prove a common source for the xenoliths and the Franciscan eclogites, the great similarity nevertheless permits the conclusion that the two rock groups had a similar mode of origin.

4) Plate tectonic models of the Western United States require the underflow of several thousand kilometers of oceanic crust beneath the North American continent during the Mesozoic and Cenozoic. Considering the most recent literature we show that an emplacement of

Franciscan eclogites beneath the Colorado Plateau is feasible and compatible with the presently available data. This process requires a horizontal translation of approximately 800-900 km between 80-75 m.y. (the approximate end of Franciscan metamorphism and the magmatism in the batholith belt) and 30 m.y. ago (the time of the kimberlite emplacement). The survival of lawsonite in some of the xenoliths places the limit of downward movement at about 50 km.

Our model invokes a combination of subduction and underplating resulting from the consumption of oceanic lithosphere in trenches along the western margin of North America and the active westward movement of North America following the opening of the Atlantic.

This interpretation of the origin of the eclogite xenoliths differs radically from one proposed recently by McGetchin and Silver (1972) in a crustal-upper mantle model for the Colorado plateau based on a suite of inclusions identical to that used in this study. If correct, the model presented here has important implications for the tectonic evolution of the southwestern United States. It would constitute direct proof that large scale underflow of oceanic crust and mantle beneath the North American continent has indeed taken place.

References

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