STRUCTURE AND PETROLOGY OF THE CONTINENTAL LITHOSPHERE: METHODS AND INITIAL RESULTS FROM THE COCORP PROGRAM

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The study of xenolith suites from kimberlites and alkali basalts in conjunction with deep seismic reflection profiling is potentially a powerful method for exploration of the petrology and structure of the lower continental crust and mantle. The xenoliths provide information on the identity of rock units and the seismic profile provide information on the shape, distribution, and structure of rock bodies. Additional evidence can be obtained by direct observation of lower crustal sections such as the Ivrea zone (Berckhemer, 1969). Using these data in a fashion analogous to that of the seismic stratigraphers of the petroleum industry, it may be possible to piece together a regional picture of the lower crust and upper mantle. In this paper, we review the status of the COCORP deep seismic profiling program and describe the beginnings of our study of xenoliths from two localities near profiling sites.

Deep seismic reflection profiling of the lower crust and upper mantle is being carried out an an on-going project by the Consortium for Continental Reflection Profiling (COCORP). The COCORP program is funded by the National Science Foundation and is part of the United States Program for the International Geodynamics Project. State-of-the-art seismic reflection techniques are used to provide the high resolution of structure needed to study fundamental geologic problems of the continental crust and upper mantle. Field experiments were begun in Hardeman County, Texas where data were collected along three lines totalling a distance of 36.8 km using a 24-fold CDP stack. Information was obtained on intrabasement diffractors and reflectors to depths as great as about 45 kilometers. Reflectors in the upper part of the section are continuous over the length of the profile and give information on apparent(?) faulting and unconformities deep in the crust. Lower level reflectors are less continuous but zones and discontinuities may be distinguished on the basis of spatial density, length, and dip of reflectors. Zones of low reflector density may represent plutons and some hyperbolic events may indicate deep folded structures (see Oliver et al., 1976). The lower crust appears to be an area of great complexity of structure and rock types, much greater than indicated by other types of geophysical studies.

The second COCORP study was carried out across the Rio Grande Rift on the eastern margin of the Albuquerque Belen Basin in central New Mexico. This study was later extended so that a total of 165 kilometers of profiling has been completed from Abo Pass in the east to Sierra Lucero on the west. Preliminary study of the results indicates reflectors of generally limited lateral extent throughout the lower crust and possibly the mantle. Particularly impressive is a strong reflector at a depth of about 20 kilometers at Bernardo which dips to the north and corresponds with the top of the magma chamber proposed by Sanford et al. (1973). The rift margins are recognizable in the profiles and show differences in record character. Considerable structural complexity is visible in the sediments.

A third study includes a profile 52.5 kilometers in length crossing a part of the Green River Basin and the Wind River Uplift in Wyoming. This line is currently being extended to the northwest. Preliminary analysis indicates a fairly continuous reflector exhibiting both apparent offsets and topography at a depth of 11 seconds (approximately 33 kilometers). This reflector may correspond to the Moho. Abundant evidence of radial and lateral structural complexities including apparent faulting and warping of reflectors can be seen on the profile throughout the crust and upper mantle.

Field data for profiles across the Great Valley of California and the San Andreas Fault are being processed at present. Sites to be profiled in the near future are located in the Michigan Basin, the Adirondacks, and the Appalachians.

Study of xenoliths from the Leucite Hills is being undertaken as this locality is close to the Wind River seismic profile. Xenolith types are being compared to surface exposures in the Wind River Uplift. In the Leucite Hills, crustal and possible mantle xenoliths are abundant in two localities and are present at several others. Types of xenoliths collected include gabbros, anorthosites, granites, and various sedimentary rocks as described by Carmichael (1967). In addition, feldspathic gneisses, biotite-rich schists, mafic granulites, and pyroxenites have also been found to date. Further work may show some of these to be cognate xenoliths, but a large number are of foreign origin.

Field work is also underway to find xenoliths of crustal and mantle origin in the kimberlites of the Finger Lakes Region in New York. Small fragments of anothosite kindred as well as numerous sedimentary xenoliths occur in the Poyer Orchard diatreme near Ithaca, New York. A syenite xenolith has been found in a small kimberlite dike in the same area. Although crystalline fragments are not common, this locality is one of the few areas in the eastern United States where xenoliths are found. Xenoliths from the Finger Lakes Region may tie in with seismic profiles in the Adirondacks or in the Appalachians.

<u>References</u>

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