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Nd- AND Sr-ISOTOPE STUDIES ON CRUSTAL XENOLITHS FROM SOUTHERN AFRICA

C.J. HAWKESWORTH, N.W ROGERS, P W. VAN CALSTEREN, M A. MENZIES, D.L. REID
Department of earth Sciences Open University, Walton Hall, Milton Keynes, MK7 6AA, U.K.

The presence of crustal xenoliths in kimberlite pipes across much of southern Africa offers a unique opportunity to determine the horizontal, and, in some areas, the vertical dimensions of segments of continental crust of different ages. Particular questions include the balance between new and reworked crustal material in the Proterozoic mobile belts, whether the Archaean cratonic nucleii are underplated by a younger lower crust, and possible relationships between stabilisation of the crust and events in the uppermost continental mantle.

Ten samples of predominantly basic granulites from Lesotho kimberlites scatter about a whole rock Sm-Nd errorchron corresponding to an age of 1.4±.1 Ga, with an initial $^{143}Nd/^{144}Nd$ ratio slightly higher than CHUR at that time. The remaining five samples plot above that errorchron suggesting that they either represent younger material, or they were derived from a more depleted source region. In either case 1.4 Ga is the best estimate for the maximum age of the lower crust beneath Lesotho. Granite- and paragneiss xenoliths from Kimberley and two granulite facies metasediments from near Kroonstadt yield model Nd (T_{CHUR}^{Nd}) ages of 2.9-2.4 Ga, consistent with their position on the Archaean craton. However, seven of the eight samples analysed of both upper and lower crustal material from pipes in the Namagua Mobile Belt have Proterozoic model Nd ages (1.0-1.5 Ga) and only one contains any indication of a longer crustal residence time. The available evidence suggests that a considerable volume of new crust was generated in the Late Proterozoic, and that upper mantle heterogeneities of that age were subsequently sampled both by Karoo magmatism and kimberlite emplacement.

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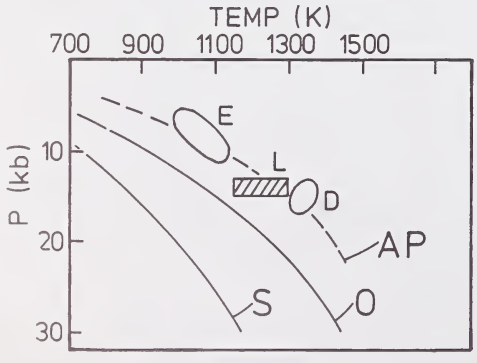
BASAL CRUST (?) FROM LASHAINE, E. AFRICA.

A.P. JONES, J.V. SMITH, E.C. HANSEN, J.B. DAWSON
Department of Geophysical Sciences, University of Chicago, Chicago IL 60637 U.S.A.

Detailed petrographic and mineralogical studies of a suite of basic garnet-plagioclase-clinopyroxenites, websterites and garnet anorthosite, indicate equilibration under P-T conditions of 1150-1300 K and 1.3-1.5 GPa. Within the uncertainties of the thermometers and barometers, all of the xenoliths may have come from the same restricted zone in the lithosphere; resembling a suite of olivine-normative metagabbros. The pressure estimates are consistent with the presence of kyanite needles in every sample bearing plagioclase, and indicate derivation from the deepest parts of the crust; assumed to be 35-40 km in this part of Africa.

The calculated temperature (1200 K) for the Lashaine granulites lies well above temperatures at ∿1.4 GPa predicted from a standard shield (S) geotherm (850 K) and even an oceanic (O) geotherm (1060 K). A new "alkaline province" (AP) geotherm is proposed, based on well constrained P-T estimates for granulite xenoliths from Delegate (D), Engeln (E) and Lashaine (L).



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LOWER CRUSTAL XENOLITHS FROM COLORADO-WYOMING STATE LINE KIMBERLITES

S.D. BRADLEY and M.E. McCALLUM,
Department of Earth Resources, Colorado State University, Fort Collins, Colorado 80523

Granulite facies xenoliths recovered from kimberlite in the state line district of northern Colorado and southern Wyoming are primarily anorthosite, leuconorite, norite, gabbronorite, hypersthene, granulite, two pyroxene granulite, two pyroxene garnet granulite, and clinopyroxene garnet granulite. No known granulite facies rocks are exposed in this area and the entire nodule population is interpreted as lower crustal in origin. The most abundant groups of lower crustal xenoliths are mafic garnet granulites in which allotriomorphic granular and cumulate textures are obscured by symplectites and coronas produced by late subsolidus reactions and exsolution. Continuous modal variation occurs between the garnet granulites and garnet clinopyroxenite or eclogite as orthopyroxene and plagioclase are eliminated.

Garnet-clinopyroxene equilibration temperatures of 570 - 690°C were obtained for the garnet granulites using the method of Raheim and Green (1974). Based on experimental work of Green and Ringwood (1972), equilibration pressures for the garnet granulites are estimated to fall in a range of 10-18 Kb. suggesting depths of approximately 30-55 km. Normative compositions of the mafic granulites are mostly equivalent to quartz tholeiite and olivine tholeiite. The mineralogy of the nodule suite suggests that the lower crust in the Colorado-Wyoming state line region is a predominantly mafic igneous-metamorphic complex. (Study supported by Earth Sciences Section of NSF, Contract EAR-7810775)

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THE IVREA ZONE, AN EXAMPLE OF THE EVOLUTION OF DEEP CONTINENTAL CRUST

A. ZINGG and J.C. HUNZIKER
Geologisches Institut, Bernoullistr. 32 CH-4056 Basel, Switzerland

Seismic and gravimetric studies have shown that the MOHO-discontinuity rises from a depth of about 30 km up to 3 km in the Ivrea