xenoliths from several localities to determine local geotherms, after making assumptions about the activities of various components in the natural solid solutions. Results on southern African peridotites compare favorably with pressure estimates made by independent geobarometers and with calculated continental conduction geotherms. Results from southwestern United States, however, indicate that the geotherm is elevated, though not to the extent of mid-ocean ridge convection geotherms. This may be due to an intermediate thermal state, involving both convection and conduction, resulting from the slow rate of spreading occurring along the Rio Grande Rift.

## D4

## GARNET LHERZOLITES FROM THE HANAUS-I AND LOUWRENSIA KIMBERLITES, NAMIBIA

R.H. MITCHELL.
Geology Department, Lakehead University, Thunder Bay, Ontario, Canada P7B 5E1

The Gibeon cluster of Namibian kimberlites is emplaced into the Orange River Belt which has accreted to the Transvaal craton. These "off-craton" kimberlites are non-diamoniferous and are younger than the diamond bearing "on-craton" kimberlites. The Hanaus-I and Louwrensia kimberlites each contain a bimodal suite of upper mantle-derived garnet lherzolite xenoliths characterized by a coarse granular or a porphyroclastic-mosaic texture. The Louwrensia pipe in addition contains garnet harzburgites in which the orthopyroxenes have exsolved lamellar clinopyroxenes. Deformed lherzolites are not iron-enriched relative to the deformation-free types. Temperatures and pressures of equilibration calculated by the Wells-Wood method are from 915-1050°C at 27-36 kb and 915-1010°C at 29-41 kb for coarse lherzolites from Hanaus and Louwrensia respectively, and from 1000-1225°C at 26-39 kb and 1010-1125°C at 33-34 kb for porphyroclastic-mosaic types from Hanaus and Louwrensia respectively. The coarse types from both localities have similar equilibration P and T's to coarse lherzolites from on-craton kimberlites and plot on the lower non-inflected limb of the South African continental shield "paleogeotherm" defined by such lherzolites. The deformed lherzolites plot randomly above this geotherm and do not define an inflected limb. These higher equilibration temperatures are considered to be due to heating, shearing and recrystallization of mantle during kimberlite formation. The lherzolite mineral compositions and equilibration conditions indicate that the Namibian kimberlites have been derived from similar depths to on-craton kimberlites and have incorporated similar mantle material. The lack of diamonds is not a consequence of derivation from atypical mantle or from regions with an unusual geothermal gradient.

## D5

## GARNET PERIDOTITES FROM WILLIAMS KIMBERLITES, NORTH-CENTRAL MONTANA, USA

B.C. HEARN JR., E.S. MCGEE
U.S. Geol. Survey 951, Reston, VA 22092, USA

Two Williams kimberlites, 250x350m and 37x390m, in the eastern part of a swarm of 30 middle Eocene alnoitic diatremes, contain xenoliths of garnet-bearing lherzolites, harzburgites and dunites. Temperatures were calculated by the Lindsley-Dixon 20 kb method for lherzolites and and by the O'Neill-Wood method for harzburgites and dunites and pressures were calculated by the MacGregor method, or were assumed to be 50 kb for dunites. Most peridotites equilibrated at 1220-1350°C and 50-60 kb, well above a 44 $mW/m^2$ shield geotherm and on or at higher P than the graphite-diamond boundary. Three lherzolites show low T-P (830-940°C, 23-42 kb) and are close to the shield geotherm. All three low T-P lherzolites have coarse texture whereas the high T-P cluster has both coarse and porphyroclastic textures, indicating a range of conditions of deformation and recrystallization in a restricted high T-P range. Maximum size of large strained olivines is as much as 2 cm. The tiny size (0.1-0.2 mm) of granulated and euhedral olivines in several xenoliths shows that deformation was occurring just prior to incorporation in kimberlite and that ascent was rapid enough to retard further coarsening of fine-grained olivine. For other high T-P peridotites, cessation of deformation before inclusion in kimberlite is suggested by larger (2mm) euhedral olivines in a matrix of fine granulated olivine or by optical continuity of large and nearby small olivines. Two low T-P lherzolites contain 5-8mm clots of moderate-Cr garnet + Cr-spinel + Cr-diopside inferred to form by reaction of an initial high-Cr garnet brought into the garnet+spinel stability field. This suggests a slower ascent or pause in ascent, compared with other peridotites containing inclusion-free, high-Cr garnets. Textural and compositional variations of peridotites are compatible with kimberlite generation and ascent during dynamic diapiric perturbation of the upper mantle.

## D6

## MANTLE GARNET-SPINEL TRANSITION ZONE DEMONSTRATED BY XENOLITHS FROM COLORADO-WYOMING KIMBERLITES

M.B. KIRKLEY[1], M.E. McCALLUM[2], D. H. EGGLER[3]
[1]Noranda Exploration, Missoula, Montana 59801,
[2]Department of Earth Resources, Colorado State University, Fort Collins, Colorado, 80523
[3]Department of Geosciences, The Pennsylvania State University, University Park, Pennsylvania 16802.

Two groups of xenoliths containing coexisting garnet and spinel have been recovered from Colorado-Wyoming kimberlites. The first group consists of pyroxenites with coarse-grained, pale green, aluminous spinel that is relatively Mg-rich and Cr-poor. Garnet in these xenoliths appears to be exsolved from aluminous pyroxene, and occurs as lamellae and as grain boundary rims surrounding pyroxenes and spinels. Xenoliths of the second group are peridotites containing fine-grained vermicular, reddish-brown spinel that is more enriched in Fe and Cr relative to Al. Some garnet in these nodules also occurs as exsolution lamellae in pyroxene, but most engulfs spinel and probably formed by the reaction *orthopyroxene + clinopyroxene + spinel = olivine + garnet* as suggested by MacGregor (1970). Utilizing MacGregor's (1974) orthopyroxene geobarometer, mineral equilibration depths of 50-100 km and 25-60 km have been calculated for the peridotite and pyroxenite xenoliths, respectively. Temperature estimates range between 590-800°C. Garnet in both xenolith groups apparently formed during or immediately prior to kimberlite emplacement and the