viously demonstrated for a suite of Bultfontein diopsides (Menzies & Murthy, 1980). Pipe emplacement initial $^{143}Nd/^{144}Nd$ ratios decrease in the sequence phlogopite-diopside-garnet such that garnet lies furthest into the "enriched" quadrant. Identification of one or more of these phases as representative of the metasomatic component is complicated by the complex histories of the host peridotites, which appear to have included previous melt extraction. If phlogopite (diopside) is metasomatic, then its source evolved with a higher Sm/Nd ratio than the host garnet harzburgite. This seems counterintuitive given the conventional high Sm/Nd ratios of garnet and is the subject of further investigation.

E17

ZONED MINERALS IN PERIDOTITE NODULES: CLUES TO MANTLE DYNAMICS

D. SMITH[1], C. WILSON[1], S. N. EHRENBERG[2]
[1]Dept Geology, Univ. Texas, Austin, Texas 78712 USA
[2]Shell Development Co., P. O. Box 481, Houston, Texas 77001 USA

Compositional zoning within peridotite phases has been measured by electron probe microanalysis in order both to constrain rates of pressure and temperature change and metasomatism in mantle peridotite and to infer relative cation mobilities in the mantle. Rocks studied include garnet-inclusion pairs from ultramafic diatremes on the Colorado Plateau, composite peridotite nodules from Kilbourne Hole, and garnet lherzolite nodules from The Thumb, a minette diatreme on the Colorado Plateau.

Results from garnet lherzolite nodules from The Thumb document metasomatism and constrain its timing. Calculated temperatures for sheared and coarse nodules are mostly in the range 1050-1400°C. Garnets in two sheared nodules have rims enriched in Fe, Ti, and Na and depleted in Mg relative to grain cores. Olivine and diopside inclusions in garnet are enriched in Mg and Cr and depleted in Na, Ti, and Fe relative to matrix phases. Matrix pyroxenes homogenized distinctly faster than garnet. Ti mobility in garnet was less than those of Fe and Mg by about a factor of 4. Our data support the earlier hypothesis that these sheared nodules formed by deformation and metasomatism of coarse peridotite. Garnets in two coarse peridotites, however, are also zoned, so deformation and metasomatism are not necessarily related. Several nodules with zoned garnets have relatively flat normalized REE patterns, and there is no evidence that the Fe-Ti metasomatism was accompanied by LREE enrichment. Comparison of observed and calculated diffusion gradients suggests metasomatism occurred within a short period (perhaps tens of years) before minette eruption.

E18

KIMBERLITE: «THE MANTLE SAMPLE» FORMED BY ULTRAMETASOMATISM

D.K. BAILEY
Department of Geology, University of Reading, England, RG6 2AB.

Even with optimum general mantle compositions and regardless of the mechanism of melt generation, a kimberlite melt fraction would be minute. Melt segregation to give localised eruption, exploiting pre-existing zones of weakness, poses insuperable problems for mechanisms of pervasive melt generation that are favoured for other types of magmatism. Neither diapiric, nor "hotplate" melting could suffice because any initial melt would be intergranular and extremely diffuse.

Experiments indicate that the kimberlite solidus inflects to a positive dP/dT between 100 and 200 km deep. Diatremic kimberlite activity is consistent with flashover eruption from the near-solidus and can originate only near the inflection, or at shallower levels. Ascent of kimberlite melt from greater depths would mean upward departure from the solidus and hence vapour undersaturation. This is the unavoidable path of deep diapirs, which would never provide the activity in its observed form. Xenolith PT trajectories, of all ages and from all cratons, are in grazing incidence with the inflection zone, indicating its critical nature, and adding to the case against rising diapirs.

Stockwork metasomatism represents a plausible alternative. It concentrates the incompatibles in linked channelways prior to melting, and eliminates the need for segregation after melting of liquid traces from a large mantle volume. The channelway extensions to the surface form the guides to kimberlite eruption once the stage of ultrametasomatism/melting is achieved.

(Late abstract)

CONTRASTING TYPES OF MANTLE METASOMATISM

J.B. DAWSON
(Department of Geology, University, Sheffield SI 3JD, U.K.)

Within the past decade, metasomatism of upper mantle peridotites has been increasingly invoked to account for major element, trace element and isotopic inhomegeneities in the upper mantle and to create source areas for volcanic rocks whose geochemical properties would be otherwise difficult to explain.

Two major types of metasamotism can be recognised:-

(1) Patent metasomatism in which textural replacement of primary phases by later generally-hydrous phases is evident. This has been recognised in kimberlite and basaltic xenolith suites and includes replacement of garnet, clinopyroxenes and orthopyroxene by amphibole and/or phlogopite. In some specimens this metasomatism is clearly related to recognisable veins or zones comprising phases rich in K, Na, Rb, Ti, Nb etc., whilst in other specimens the metasomatism is pervasive on the hand-specimen scale. A more subtle type of patent metasomatism has been recently recognised in peridotite xenoliths from S. Africa

and Tanzania in which clinopyroxene is replaced by orthopyroxene (±phlogopite and ilmenite); this is most logically explained by CO_2 flushing. In the xenolith suites from kimberlites and K-rich volcanics, K-metasomatism appears dominant, whilst in basaltic suites, Na-metasomatism is the more common; the chemistry of the host igneous rocks appears to mirror the dominant type of metasomatism. In the case of K-metasomatism of kimberlite suites xenoliths from S. Africa, the enrichment event has been placed at 150 - 200 m.y. (Erlank and Shimizu, 1977, Kramers et al., in prep.).

(2) Cryptic metasomatism is a less obvious form of metasomatism, being only revealed by comparison of major and minor element chemistry with Sr-isotope and REE chemistry. A major depletion event has depleted mantle xenoliths in "basaltic" components such as Al_2O_3, FeO, CaO and Na_2O, but upon this has been imposed an event during which the earlier refractory rocks (component A) were enriched in K, Rb light REE, and U (component B); although differing in detail, this depletion/enrichment pattern has been recognized in the granular peridotite xenolith suites in kimberlites and basaltic hosts from S. Africa, Tanzania Australia and western U.S.A. Of particular importance is the dating. This enrichment event at Lashaine, Tanzania, is dated at 2.0 b.y., and a further (calculated) age for an enriched event in the S. African mantle is at ∿ 1500 m.y. Hence it appears that some areas of upper mantle have been subjected to 2 enrichment events - one ancient, the other quite recent in geological terms.