

sions within olivine. This is presumably magnesite generated during: Forsterite + CO₂ Magnesite + Enstatite. By varying the p,T path followed during quenching one can study either the degree of incorporation of CO₂ into olivine under conditions stabilizing the carbonate or the development of features related to the generation of free CO₂. Analysis of these samples is in progress. In addition, several samples have been deformed and have developed shear zones containing mylonitic material. Thus application of pressures up to 3.0 GPa has not precluded shear zone formation.

E7 FLUID ACTIVITY IN THE MANTLE - EVIDENCE FROM LARGE LHERZOLITE XENOLITHS

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Lherzolite xenoliths in a breccia pipe from northeastern N.S.W., Australia attain diameters of up to 60 cm. They record, approximately concentric with xenolith margins, zones of alteration by hydrous and carbonic fluids which may represent metasomatism by primary mantle volatiles. Successive zones (each about five cm. wide) decrease in alteration intensity from the outside inward. The simplified sequence of mineral assemblages is: (1) quartz / talc/Mg-Fe-Ca carbonates, (2) talc/Mg-Fe-Ca carbonates, (3) fresh spinel lherzolites. Crosscutting this concentric alteration pattern are discrete carbonate veins, rarely radial with the xenolith shape, but commonly *en echelon*.

The zonal nature of the alteration suggests that fluid invasion occurred either (a) after entrainment in the host basaltic liquid or (2) within the mantle prior to entrainment and possibly resulting from fluid activity genetically linked with the production of the host magma. If the major alteration event took place in the mantle, this implies that brecciation associated with volatile movement can occur within the mantle. This may provide a mechanism for xenolith entrainment which commonly takes place within a vertically limited horizon.

Abundant carbonate of light isotopic character is present in the host basalt and may be of primary mantle origin. This evidence of a high CO₂ content may be significant in carrying such large xenoliths to the surface.

E8 MAGNESITE AND OTHER MINERALS IN FLUID INCLUSIONS IN A LHERZOLITE XENOLITH FROM AN ALKALI BASALT

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Magnesite has been observed in CO₂-rich fluid inclusions in a typical Cr-diopside and spinel-bearing lherzolite recovered from the 1824 eruption of Lanzarote volcano, Canary Islands. The carbonate, which exists as 2-4 µm diameter crystals on inclusion walls, was identified by its rhombohedral form and electron beam-generated EDS

and WDS characteristic x-ray spectra in which C and Mg are major elements. The carbonate occurs as the sole phase in individual inclusions and has only been found in those inclusions enclosed in olivine. Phases present in other inclusions in olivine include Fe-oxide (probably pure magnetite), Fe- and Cu-Fe-sulfides, and silica. Although sulfides and magnetite may exist together in the same inclusion, most magnetite-bearing inclusions contain no other phases.

Regardless of the phases in them, mineral-bearing inclusions tend to possess irregular shapes, are relatively large (10-30 µm) and exist together in arrays which define non-crystallographic surfaces. These features distinguish them as a group from all other inclusion populations in which daughter minerals are absent.

The production of carbonate by reaction of olivine and CO₂-rich fluid requires only that CO₂ fugacities be sufficiently high for any set of assumed conditions, i.e., the mere presence of magnesite yields no information on the T and P at which it formed. However, the apparent lack of phases more siliceous than olivine, e.g., enstatite or glass, in association with magnesite (or magnetite) means that either olivine in the immediate vicinity of the inclusion is non-stoichiometric, or the carbonate crystallized in a microfracture before annealing of olivine and formation of the inclusion, presumably at mantle P-T conditions.

E9 THE MINERALOGY, STRUCTURE AND MODE OF FORMATION OF KELYPHITE AND ASSOCIATED SUB-KELYPHITIC SURFACES ON PYROPE FROM KIMBERLITE.

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The mineralogy, structure and mode of formation of kelyphite shells surrounding garnet is discussed in relation to kimberlite emplacement. Pyrope encrusted by kelyphite is commonly found in most garnet peridotites, some eclogite xenoliths from kimberlites, as well as a few garnet-bearing serpentinites. Observations made with the aid of a scanning electron microscope on 858 kelyphite-encrusted garnet grains from 30 kimberlite occurrences and petrological examinations of kelyphite rims enclosing garnet in ultrabasic nodules from kimberlite are discussed.

Although the relative abundance of kelyphite-encrusted garnet varies from one kimberlite to another, kelyphite shells are most commonly developed on mauve garnets which are most probably derived from peridotite and are least commonly found on orange varieties from eclogites. The underlying sub-kelyphitic surfaces formed on pyrope as a result of kelyphitization are described. There is a direct relationship between the different types of surface features found on the sub-kelyphitic surfaces and the structure and mineralogy of the kelyphite shells surrounding garnet and filling cracks within garnet.

During the ascent of kimberlite magma garnet lherzolite nodules are moved upwards from depths of approximately 150 km within the upper mantle resulting in the kelyphitization of pyrope within the peridotite nodules, forming shells consisting of a spinel-two pyroxene assemblage. The proposed zone of kelyphitization of pyrope lies within the spinel lherzolite stability field and is most likely to occur at temperatures of 900°C