

CO₂-CO FLUIDS IN A VEINED NODULE (NEVEDA) :
IMPLICATIONS FOR OXYGEN FUGACITY.

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A wehrlite nodule from the Marcath flow, a late Cenozoic alkali basalt of the Lunar Crater volcanic field (LCVF), contains a 1 cm wide vein (80 % amph, 15 % fsp (An50), and 3 % ilm) which chemically resembles an alkali basalt. The vein has been interpreted to result from the intrusion and subsequent crystallization of a relatively primitive alkali basaltic magma into a wehrlite mass in the upper mantle or lower crust (BERGMAN et al., 1981, EPSL, 56, 343). CO₂-rich fluid inclusions occur in fsp, cpx, ol, and amph in both the vein and host wehrlite. By Raman spectroscopic analysis, CO is identified only in the vein fluids (XCO = 10 mole %). Using the CO-CO₂ fluid compositions and fugacities, oxidation states of the fluids in the vein phases are near QFM (log fO₂ = -9 at 1200°C), whereas, those in the host wehrlite are more oxidized (log fO₂ > -7). On cooling below 1000°C, the CO-CO₂ fluids reaches the stability field of graphite. Inside the inclusions, the lack of graphite and the presence of CO proves that these fluids can be considered as "quenched" fluids and hence are suitable for isochore and chemical equilibrium computations. The fO₂ of the vein fluid is in the range reported for basaltic extrusives and suggests that the vein's parental magma had an oxidation state at depth similar to surficial basaltic lavas. Fluids within the wehrlite are compositionally different from those in the vein and suggest that (a) these two fluid generations did not equilibrate over the scale of <5 mm and (b) the primitive alkali basalt intruded a wehrlite significantly more oxidized.

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COMPOSITIONS OF FLUIDS IN EQUILIBRIUM WITH
PERIDOTITE AND IMPLICATIONS FOR ALKALINE
MAGMATISM-METASOMATISM

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Calculations of the fO₂ of peridotitic mantle from olivine-orthopyroxene-ilmenite assemblages indicates high-pressure oxidation conditions very close to the BHD buffer:
 $\log fO_2 = 7.61 - 23872/T + 0.064(P-1)/T$

These conditions, also near the MW buffer, are compatible with graphite or diamond stability, carbonate stability, and, most importantly, with presence of fluids consisting of H₂-CO₂, not H₂-CH₄ or CH₄.

Solubilities in H₂O and H₂O-CO₂ fluids in equilibrium with enstatite-forsterite-diopside-peridotite and enstatite-forsterite-diopside-spinel-amphibole peridotite have been determined at 15-20 kbar and 750-1100°C. Amphibole peridotite fluids principally contain silica, alumina, and alkalis in total amounts less than 3 wt % in H₂O fluids and 0.5 wt % in H₂O-CO₂ fluids. Phlogopite peridotite fluids are broadly similar but contain a minimum of 16 wt % solute. Such fluids could significantly alter local regions of the mantle deeper than about 90 km by alkali metasomatism, although alkalis are accompanied by approx. equal molar alumina and considerable silica.

The region near 90 km, near the lower pressure limit of the carbonate stability and the upper limit of amphibole stability, is the most likely region of significant fluid solute precipitation and metasomatic alteration. This region probably yields highly alkaline magmas but not kimberlites.

Fluids Coexisting with En-Fo-Phlogopite

P(kb), T(°C)	15,1080	20,1100	20,1100
X _{H2O} (%)	1.0	1.0	0.8
SiO ₂	72.2	71.3	64.8
Al ₂ O ₃	14.1	14.0	17.0
MgO	5.3	5.6	3.5
K ₂ O	8.4	9.1	14.7

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