Absarokites from the Western Mexican volcanic zone: Constraints on mantle wedge conditions

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High-pressure experiments have been carried out over the pressure range of 1.2 to 2 GPa under anhydrous and hydrous conditions on a primitive absarokite (M102), from the Mascota region in Western Mexico. Sample M102 (Carmichael et al 1996, Journal of Petrology **40**, 1301) is characterized by. high Mg# 0.73 (all Fe as FeO) and contains equilibrium Fo90 olivine phenocrysts, indicative of a relatively unmodified mantle melt. The high concentrations of Na≠O 3.53wt% and K≠O 1.41wt% and the correlation of K2O with other soluble elements are evidence for modification of the source region by a slab-derived component. The phase relations of these absarokites provide an opportunity to investigate the thermal structure of the mantle wedge and the effects of metasomatism on melting process.

The anhydrous composition is saturated with olivine and orthopyroxene as liquidus phases at 16kbars and 1400°C. At the same pressure clinopyroxene appears only 30°C below the liquidus. Therefore the unmodified composition is almost saturated with lherzolite residue, but not with an aluminous phase. The pre-eruptive H_2O contents of these lavas have been estimated to range between 3.5 and 6wt%. The composition of M102 with 5wt% H≠O added is in equilibrium with olivine and orthopyroxene at 14kbars and 1200°C, below the liquidus. Due to significant Fe losses in the wet runs this is a preliminary result, but it indicates that the melt + olivine + orthopyroxene equilibrium has moved to lower pressure relative to the dry composition. In contrast, Gaetani and Grove (1998,CMP **131**, 323) found that the addition of H_2O to low alkali melts had the opposite effect, pressure of multiple saturation increased with increasing H_2O.

Studies of the regional geoid estimate the depth of the Moho beneath the Jalisco Block at ~39km depth, while seismic studies locate the top of the slab in the region at ~60km (Pardo & Suarez 1995, JGR **100**, 12,357). The dry parental melt of the Mascota absarokites, last equilibrated with lherzolite at ~50km depth, just above the mantle wedge, and suggests high temperatures in the shallow subduction zone.

A carbon budget for Canadian Shield lakes

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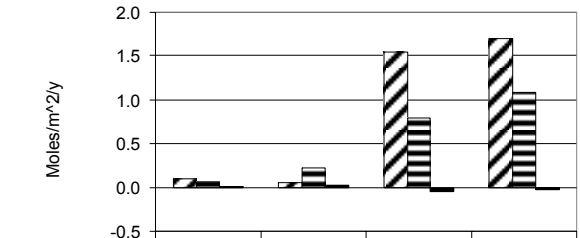
Methods

Dissolved and particulate organic carbon and dissolved inorganic carbon monitored in all of the inflows, outflow, and direct precipitation to Lake 239 at the Experimental Lakes Area from 1971 to 1996 were used to construct a mass budget for carbon. These components were also monitored in the lake so that the change in mass could be calculated. Estimates of carbon deposition in sediments were taken from Kipphut (1978) and from ^{210}Pb dated cores from other similar lakes in the area. Gas exchange losses of CO_2 were calculated from data in the period 1991 to 1998 in Lake 239.

Results and Discussion



	Susp C	DIC	DOC	Total C
Missing	0.097	0.057	1.543	1.696
Outflow	0.060	0.224	0.793	1.077
Change in Lake	0.004	0.024	-0.053	-0.025

Figure 1. Carbon budget for Lake 239 from July 1971 to July 1996.

The change in the total carbon content in the lake water over the 25 years was negligible (Figure 1). Of the 2.8 moles m^{-2} y^{-1} that entered the lake, 1.1 moles m^{-2} y^{-1} left via the outflow and 1.7 moles m^{-2} y^{-1} was “missing”, that is, went to the sediments or the atmosphere.

Cores showed that between 0.7 and 1.2 moles m^{-2} y^{-1} accumulated in the sediments, leaving 0.5 to 1.0 moles m^{-2} y^{-1} to be lost via gas exchange. Independent estimates of gas exchange losses based on CO_2 concentrations and wind speed gave values of near 1.0 moles m^{-2} y^{-1}. Clearly DOC must provide the carbon for sedimentation and gas evasion.

References

Kipphut, G.W. 1978. An investigation of sedimentation in lakes. Ph.D. Thesis. Columbia University, New York.