Gallium oxide solubility in vapor and indicators of heterogeneous fluid filtration

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The solubility of gallium and aluminum oxides in gas phase in the system Ga_2O_3 (Al_2O_3)-HCl-H2O was studied at 200-350ºC and pressure up to saturated vapor. The concentration of gallium increases with the increasing of HCl pressure. The formulae of gallium gaseous specie was determined as $GaOHCl_2$. The constant of gallium oxide solubility reaction was calculated at 200, 250, 300 and 350ºC. The concentration of aluminum in gas phase is insignificant in the same conditions. The possibility of gallium transportation in gas phase with small quantity of Al allow to separate this elements in hydrothermal processes with gas phase. The Ga/Al ratio can be used as the indicator of gas phase separation and condensation. The separation of gas and liquid phases was determined on greisen deposits by carbon isotope fractionation of carbon dioxide in fluid inclusion. The important feature of both ore mains is heterogenization and boiling of ore-forming fluids. Greisen ore bodies are formed as a result of strongly focused fluid flow in the T-P gradient fields. Gas and liquid phase separation specifies the vertical zonality of quartz type veins. The gas phase with the high gallium concentration is separated from a flow of liquid phase. Liquid phase react with the granites forming greisen metasomatites. Condensation of the gas phase in upper parts of massive produces the increasing of Ga/Al ratio in muscovite 3-5 times more, then in granites and bottom part of vein (from $2 \cdot 10^{-4}$ to $8 \cdot 10^{-4}$ mass ratio). The muscovite type veins has no separation between gas and liquid due to there thickness and small pressure gradient. There is no difference in Ga/Al ratio in muscovite from this veins. The Spokoinoe deposit is classified by mineralized dome type. The heterogenization of fluid occurs in H_2O-CO_2 system for water phase and carbon dioxide with temperature decreasing. Two-phase flow is separated in granite, forming greisen metosomatites. The Ga/Al ratio in rock increase up to 3 times to the upper part of metasomatitic zone. The Ga/Al ratio in muscovite can be applied for other hydrothermal systems for geochemical indicator of gas phase separation and condensation zone determination.

Geochemical evidence for lithosphere delamination beneath the central Rio Grande rift

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Seismic studies have shown a low-velocity zone in the mantle that extends up to the Moho (~40km) beneath the central Rio Grande rift (RGR). Gao *et al*. [1] interpreted the low velocity zone to be the result of delamination of the original (≥100km thick) Proterozoic lithosphere and replacement with hot asthenosphere. However, hydration or melt infiltration of the lithosphere could also produce the observed low wave speeds. We have examined the geochemical signatures of spinel peridotite xenoliths hosted in alkalic basalts erupted near Elephant Butte, NM, USA in the central RGR in order to determine their chemical affinity (old continental lithosphere or young asthenosphere), and thereby test the delamination hypothesis.

Peridotite xenoliths from Elephant Butte can be divided into two distinct groups. One group is commonly fine grained and displays foliation. These are relatively fertile (3.5-4.5 wt.% Al_2O_3), have depleted Sr- and Nd-isotope signatures (e.g. $^{87}Sr/^{86}Sr \approx 0.7018$-0.7025), $^{187}Os/^{188}Os$ ranging from 0.124-0.130, and are LREE depleted with flat M-HREE. These signatures are similar to fertile abyssal peridotites, thought to represent the convecting upper mantle. In contrast, the other group are coarser grained, more refractory (~1.5wt. % Al_2O_3), display LREE enrichment, unradiogenic $^{187}Os/^{188}Os$ (~0.120), radiogenic $^{87}Sr/^{86}Sr$ (0.7041-0.7043) and lower modal abundance of CPX. These signatures are characteristic of Proterozoic SCLM. Two-phase pyroxene geothermometry of xenoliths from Elephant Butte shows no significant difference in temperature (~1000°C) between the two groups. Based on a local heat flow of 90mW/m^2 these temperatures correspond to a depth of ~45km.

The fertile xenoliths most likely represent convecting asthenospheric mantle that has recently replaced the lithosphere. The refractory xenoliths represent Proterozoic lithosphere which has undergone varying degrees of ancient melt depletion and metasomatism. This indicates that lavas from Elephant Butte are sampling the lithosphere asthenosphere boundary which lies at ~45km depth and that significant thinning of the lithosphere has occurred, consistent with the delamination hypothesis of Gao *et al*. [1].

[1] Gao *et al*. (2004) *J Geophys Res* **109**, B03305.