PRELIMINARY GEOTHERMOBAROMETRIC AND METASSOMATISM STUDIES ON MANTLE XENOLITHS OF KIMBERLITES AND ASSOCIATED ROCKS FROM THE ALTO PARANAIBA, SE BRAZIL.

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Introduction. The Upper Cretaceous Alto Paranaiba Igneous Province in SE Brazil lies within the alloctonous Upper Proterozoic Brasilia Mobile Belt (circa 800-550 Ma). This belt is thin skinned over the São Francisco Craton, the deep limits of which are not yet precisely defined. The magmatism of this Province is characterized by contemporaneous mafic to ultramafic, potassic to ultrapotassic rocks of kamafugitic, lamproitic and kimberlitic magma types and carbonatite complexes in one of the largest volume potassic volcanism in the world (Gibson et al. 1995).

The methodology in the present study included careful sampling, treatment and detailed petrographic and chemical mapping of the mantle xenolith's mineral grains from six pipes of kimberlitic (Três Ranchos), kamafugitic (Indaiá, Pântano, Serra do Bueno) and lamproitic (Mata do Lenço, Bocaina) nature. The xenoliths seldom exceed 3 cm in diameter, being often present as microxenoliths (0.3 to 1.6mm). They can be preliminary divided into the following main groups: a) garnet lherzolites, b) phlogopite peridotites and phlogopitites associated with chromite, or ilmenite, or Al-spinel and c) layered pyroxenites and dunites (not described here). Eclogite xenoliths were not found.

Garnet lherzolites. Garnet lherzolites and garnet xenocrysts were extracted from the Três Ranchos kimberlitic pipe. The xenoliths show equilibrated coarse or tabular granoblastic and non-equilibrated textures with zones of olivine neoblastesis and pyroxene alteration. Within the equilibrated textures the pyroxene grains show a constant core composition with no or only minor border variations. These xenoliths are low-temperature garnet peridotites similar to those described by Boyd (1987) for the Kaapvaal Craton. Garnet macrocrysts are Ca-Cr pyropes (G9) which plot within the normal lherzolite trend towards knorringite composition (more Cr than Ca enrichment).

P-T estimates for the equilibrated mineral cores of two garnet lherzolite xenoliths using the BK(90) geothermobarometer (Brey & Kohler 1990) yield pressure values of 60.1 and 63.5 kb and temperatures of 1072 and 1092°C, within a geotherm around 36 mW/m^2, well within the diamond field and confirming our preliminary results (Leonardos et al. 1993). Equilibration temperatures for garnet xenocrysts with inclusions of diopside confirm these very low mantle temperatures and matches those found by Esperança et al. (1994). Therefore, the lithospheric mantle beneath Três Ranchos region seems to be very deep and cold in relation to other world wide "peri-cratonic" regions. As suggested by seismic

studies of SE Brazil (James et al. 1993) there is no thermal anisotropy at least down to 200 km.

Phlogopite peridotites and phlogopitites. Small phlogopite-bearing xenoliths that seldom attain 1.5 cm in diameter are ubiquitous in most pipes. These xenoliths are formed by: a) infiltration of phlogopite associated with Al-spinel or ilmenite or chromite in anhydrous peridotite paragenesis; b) phlogopite-chromite or phlogopite-ilmenite with intercumulus diopside showing ortho and adcumulate textures; c) phlogopite harzburgites with no infiltration texture.

The phlogopite chemistry shows a continuum between a more primitive Al-rich, Ti-poor type and evolved Ti-rich type with higher Al contents. The phlogopites in garnet keliphitic borders, along fractures and as rims on the Al-Ti rich phlogopites show a strong trend towards Al-Ti poor members. Such trend together with oxide compositional trends suggest an evolution of the phlogopite paragenesis from chromite- to ilmenite- to Al-spinel-bearing assemblages.

The diopsides associated with these assemblages show a corresponding variation in their Ca content. Low Ca diopsides (#Ca=0.74 to 0.80) are related to garnet, medium Ca diopsides (#Ca=0.79-0.86) to ilmenite and chromite paragenesis and high Ca diopsides (#Ca=0.9 to 0.97) to Al-spinel phlogopite infiltration in peridotites. This probably means that the higher calcium content of the diopside in metassomatic paragenesis the shallower is the metassomatic process.

The observed transformation of enstatite in the Indaiá I phlogopite harzburgite into endiopside when in contact with phlogopite, together with the Ca-diopside enrichment trend, show that Ca-metassomatism is an important process in the kamafugite magma genesis as previously suggested by Gibson at al. (1995), but the process may be produced by K-Ca rich silicate fluids rather than a carbonate melt. Ca-metassomatism appears to be exclusively related to the phlogopite-oxide infiltration, as the xenoliths seldom contain carbonate-phases and no Cpx infiltration or enstatite reaction with dolomite were found.

The evolutive trend for phlogopites in the xenoliths are also shared by matrix phlogopites of the host rocks, suggesting a direct relation between them and that. At least part of the mantle infiltration processes is related to the Alto Paranaíba magma genesis, as also suggested by Tallarico & Leonardos (this volume).

Discussion. The suggested chemical continuum between cumulate and infiltrated mestassomatic assemblage (with Al-spinel) types here described imply that fluid interaction with peridotite minerals and/or silicate melt fractionation took place from deep to shallow levels in the mantle, as some indication of depth is given by the presence or absence of Al-spinel. It is possible that mantle heterogeneities are more strongly related to vertical than to lateral distribution of metassomites.

The silicate "melt" originating magmatic phlogopitites with ilmenite or chromite plus diopside is obviously enriched in K, Ca, Al, Fe and Ti to some extent, and so it would be the "fluid" related to infiltration processes. The presence of C and S in the metassomites are

also indicated by carbonate (barium dominated, Tallarico 1993 unpubl. thesis) and sulfate (Sr dominated) exsolution lamellae in more evolved high Al-Ti phlogopites. Some of these incompatible elements may have been provided by the plume activity. Interaction between astenospheric and lithospheric isotopic reservoirs or melting of variably enriched portions of the lithosphere is proposed for the Alto Paranaíba potassic rocks by Bizzi et al. (1994). However, the evolution of the fraction melts produced after the plume thermal impact may have comprised more complex processes to the generation of such a range of magma types in the Province, involving fractional crystallization as suggested by the presence of magmatic mantle xenoliths chemically related to the hosts.

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