SM - ND SYSTEMATICS IN ECLOGITES FROM SIBERIA

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Gnt, Cpx and, due to high modal abundance, Opx are mainly responsible for the geochemistry of REE, Sr and Pb in terrestrial mantle. K, U, Th, Rb, however, are incompatible to these minerals. The major phases containing REE are Gnt and Cpx, while Opx and Ol contain negligible amounts of LREE. Sr and Pb, on the other hand, do not enter the Gnt structure and are therefore restricted to Cpx. Compatibility and partition of trace elements might drastically change with phase transitions or also with P-T dependent solid solutions of these minerals. For example, Cpx might incorporate Sr, but when this Cpx is transformed into Gnt structure, the Sr is possibly incompatible to this mineral and might be lost. When this Gnt is transformed back into Cpx structure by decompression, we would find an extremely Sr-poor Cpx. BB?

The modal amounts of Cpx and Gnt are temperature and pressure dependent. Firstly, reactions such as Ts + Wo → Gnt are frequently observed in eclogites and pyroxenites as exsolution of Gnt from the Cpx. On the other hand, the dissolution of Cpx in Gnt postulated by Ringwood (1967) results in Gnt with a low Al/Si ratio. Sobolev (1974) reported Gnt with an excess silica content in diamond-bearing eclogites from Siberia. Moore and Gurney (1985) also reported garnet inclusions in diamonds with considerable amounts of dissolved Cpx.

Nd and Sr isotopes are measured in a number of eclogites. Sample BD 1934 (Fig. 1) is an eclogite from Tanzania (donated by J.B. Dawson), in which Gnt is exsolved from the pyroxene. The different generations of Gnt have different Nd isotopic compositions. The isochron defined only by the petrographically different Gnt has an apparent age of 1.5 b.y., but the isochron defined by Gnt and Cpx gives an age of 1.75 b.y. The obtained results of sample BD 1934 suggest that this eclogite has a slow cooling history from 1200°C to 800°C with a cooling rate of <5°C/m.y. It might be possible that this age and cooling history represents the incorporation of this eclogite into the lithosphere.

The sample OBNA 0062 (donated by G. Kurat) is an eclogite from Siberia with Gnt exsolution within the Cpx. The distribution of Gnt within the Cpx matrix is shown in Fig. 2. This sample is isotopically heterogeneous on a cm-scale as shown in Fig. 1. The variation (40 ε) of Nd isotopes is greater than observed in the full range of oceanic basalts. The isotopic variation could be caused by an open system. Gnt and Cpx are close to isotopic equilibrium as in the normal high temperature lherzolites, indicating that this sample comes from a temperature range above the closure temperature of Nd diffusion in Cpx. This could well be the asthenospheric mantle.

Another remarkable and puzzling observation is the low Nd and Sm concentration in the Cpx and Gnt of this sample (50 - 75 ppb) and their very depleted Sm/Nd ratio. This depleted character and the low Sm and Nd concentrations possibly indicate that this sample was derived either from a garnetite or an amphibole before converted into an eclogite.

JW 604 is a diamond-bearing eclogite (donated by N.V. Sobolev) with graphite, rutile and disthene. The Gnt of this sample has excess Si indicating that Cpx is dissolved in the Gnt. The different generations of Cpx and Gnt show only slight variations in isotopic composition. The age of equilibration between Gnt and Cpx is about 340 m.y. (Fig. 1), possibly close to the emplacement age of the kimberlite. Sm and Nd concentrations of the minerals from this sample are between 0.5 and 2 ppm and therefore quite normal for eclogitic minerals. On the other hand, the Gnt in this sample is enriched in Nd and Sm relative to the Cpx which is surprising. This could indicate that if Si in the Gnt is in 6fold coordination, the lattice of the Gnt is widened as shown by experimentally measured lattice parameters (Irifune et al. 1986) and the Gnt is more compatible for REE trace elements.

Isotopes results are also reported from subcalcic Gnt separated from diamond-bearing harzburgites and dunites from the Odajanai Mine, Siberia. Gnt has remarkably unradiogenic Nd (-38ε) and unusually high concentrations of Sm, Nd and Sr. From the fact that this Gnt is subcalcic we know that this composition is only stable in a Cpx-free environment like harzburgite. In contrast to the subcalcic garnet from S. Africa, which are found there in mineral concentrates, these Gnts are separated from actual rocks. The isotopic composition of the Siberian Gnts are very similar to the Gnt from S. Africa as reported by Richardson et al. (1984). Considering the isotopic variations found in these rocks the significance of a model age seems to be questionable. Possibly, the subcalcic Gnts are in reaction equilibrium with the Opx.

The Sm/Nd variations observed in these examples of subsolidus equilibrium between Gnt and pyroxene are bearing important consequences on the isotopic systems. The isotopic signature on basalts and rocks equilibrated with melts gives a volume integrated information which might not be specific for a certain mantle segment.

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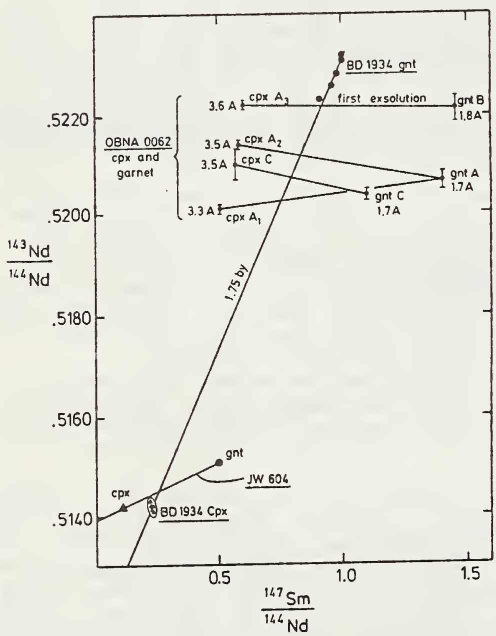

Fig. 1: Nd-isochron of Siberian eclogites.

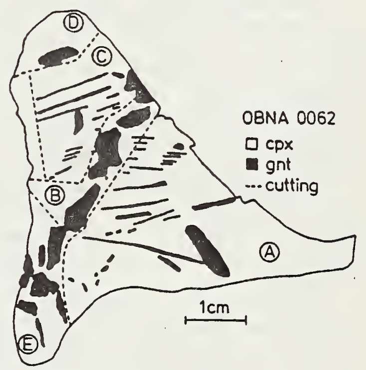

Fig. 2: Garnet distribution of OBNA 0062.