GEOCHEMISTRY OF PERIDOTITES, PYROXENITES, AND ECLOGITES IN THE GFÖHL NAPPE: CONSTRAINTS ON VARISCAN EVOLUTION OF LITHOSPHERE AND ASTHENOSPHERE IN THE BOHEMIAN MASSIF

L.G. MEDARIS, JR.[1], B.L. BEARD[2], C.M. JOHNSON[1], J.W. VALLEY[1],

M.J. SPICUZZA[1], E. JELÍNEK[3] & Z. MÍSAŘ[4]

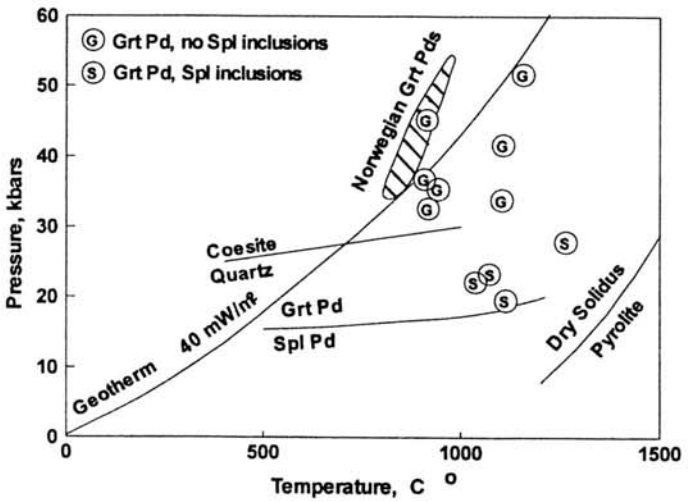
[1] *Dept. of Geology & Geophysics, University of Wisconsin, Madison, WI 53706, USA*

[2] *Dept. of Geology, University of North Carolina, Chapel Hill, NC 27599, USA*

[3] *Dept. of Geochemistry, Mineralogy & Crystallography, Charles University, 12843 Praha 2, Czech Republic*

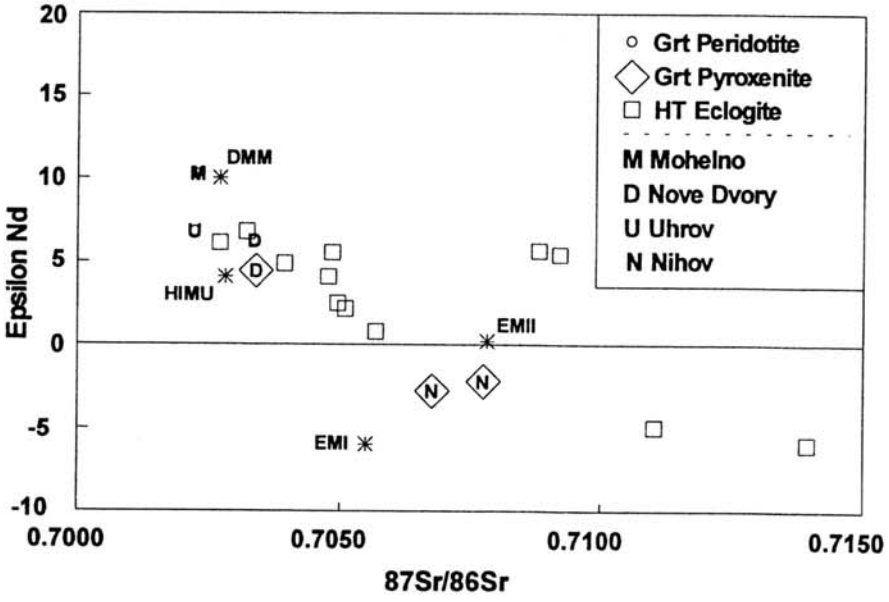
[4] *Dept. of Geology, Charles University,12843 Praha 2, Czech Republic*

Peridotites and eclogites are widely distributed in several tectonostratigraphic units in the Bohemian Massif, but garnet peridotites and associated high-temperature (HT) eclogites occur only in the Gföhl nappe. Thermobarometric calculations and geochemical analyses demonstrate that peridotites in the Gföhl nappe were derived from both asthenospheric and lithospheric mantle and that HT eclogites were formed by high-pressure crystal accumulation of garnet and clinopyroxene from melts of subducted oceanic lithosphere.



Garnet peridotites can be divided into two groups, one in which garnet is the earliest aluminous phase (900–1200 °C, 30–50 kbars), such as the Nové Dvory peridotite, and another in which spinel (as inclusions in garnet) is the earliest (1000–1250 °C, 20–30 kbars), as in the Mohelno peridotite.

Both types of garnet peridotite are depleted in major and incompatible trace elements with respect to primitive mantle, but the Nové Dvory peridotite is more depleted for a given MgO content than is the Mohelno peridotite. Elemental and isotopic compositions are decoupled, with ε_{Nd} and $(^{87}Sr/^{86}Sr)_i$ being +10.2 and 0.70226 for acid-washed Cpx at Mohelno and +6.3 and 0.70334 at Nové Dvory. Garnet pyroxenites are enriched isotopically compared to peridotites, yielding values of +4.4 to −2.4 and 0.70338 to 0.70666.



HT eclogites (800–1200 °C) occur as lenses in peridotite and have: high Mg numbers (commonly >70), no correlation between different elements and fractionation parameters, and positive, as well as negative, Eu anomalies. Values of ε_{Nd} and $(^{87}Sr/^{86}Sr)_i$ for Cpx range from between DMM and HIMU to beyond EMII. Two samples have high ε_{Nd} values of +5.4 and +5.7, relative to $(^{87}Sr/^{86}Sr)_i$ of 0.70884 and 0.70928.

Sm–Nd Grt–Cpx ages group at ~375 or ~340 Ma

for 14 samples of peridotite, pyroxenite, and eclogite. No correlation exists between the two age groups and rock type or position within the Gföhl nappe, except that rocks within a given complex yield the same age.

$^{18}O/^{16}O$ ratios have been determined by laser heating and fluorination of Cpx and Grt separates. Cpx and Grt are in high-temperature oxygen isotope equilibrium, with $\Delta_{Cpx-Grt} = -0.06 \pm 0.29$ (1σ) per mil. $\delta^{18}O_{SMOW}$ values for Cpx in peridotite, pyroxenite, and eclogite are 4.7–5.3, 4.8–5:0, and 3.8–5.8, respectively. Most values for $\delta^{18}O_{SMOW}$ in HT eclogite are <5.0 corresponding to the light values obtained in other studies for certain eclogite xenoliths in kimberlite.

The Mohelno-type peridotite (higher temperature, isotopically depleted) may be asthenospheric mantle, and the Nové Dvory-type peridotite (lower temperature, relatively enriched isotopically), lithospheric mantle. Geochemical characteristics of HT eclogites (Nd and Sr isotope variability, low $\delta^{18}O$, Eu anomalies, and cumulate chemical compositions) indicate that they probably were derived from melts of subducted, hydrothermally altered oceanic lithosphere. Such a lithologic association could have formed in a marginal basin setting, in the mantle wedge overlying a subduction zone, during closure of an ocean basin between Gondwana and Baltica. Alternatively, these rocks may have formed beneath thickened continental crust, soon after collision of Gondwana and Baltica, in response to lithospheric delamination and asthenospheric upwelling. The latter scenario is preferred, because it would provide a heat source for crustal melting and generation of the abundant Variscan granitoids.

NORTHERN LIMIT OF NAPPES, VARISCAN OROGEN, RHENO-HERCYNIAN ZONE (HÖRRE, KELLERWALD, HARZ)

D. MEISCHNER

Institut für Geologie und Paläontologie, Abteilung Sediment-Geologie, Goldschmidtstrasse 3, D 37077 Göttingen, Germany

Recent interpretations of the Rheno-Hercynian zone postulate nappes that are thought to have become emplaced in a late phase of the Variscan orogeny, and in the uppermost etage of the orogen. The northern limit of such nappes varies between individual authors. The supposed nappes consist of Devonian and Carboniferous greywackes with inclusions of neritic and pelagic sediments of Silurian to Middle Devonian age which are interpreted by mobilistic authors as either olistoliths or chips of older basement lined up along the overthrusts, whereas more fixistic authors regard them as steep anticlines in the greywackes. The clearly neritic Lower Carboniferous Kellerwald-quartzite is also included, by some authors, in the group of nappes.

From the northern margin of the Harz Mts. through to the Hörre district, i.e. over 200 kms, the lateral arrangement of the supposed nappes is strikingly uniform. The situation is most clear in the Kellerwald area where the sedimentary units are thrusted one above the other in a very regular pattern. Individual units can be traced along the strike to the Harz Mts. where the whole pile of rocks occurs in steeply dipping structure, but still in the same sequential order. Things are less clear in the Hörre where the lower parts of the basically flat-lying units is available only since the upper etages are eroded away.

On close inspection, however, no clear outer limit of nappe tectonics can be recognized in the field. Structurally, there is no contrast between the supposed nappes and the autochthonous basement. Both have the same intensity of deformation and the same style of imbricate structure, steep in the case of the Harz, medium-flat in the Kellerwald and the Hörre. More problems arise when certain characteristic sediments are considered. E.g.: Identical Upper Devonian neritic sandstones occur below the Kellerwald-quartzite and in the autochthonous series outside the proposed nappes (Ortberg- and Aschkoppe- sandstones) in the Kellerwald and in the Dill-syncline. It can be demonstrated by detailed facies analysis that neritic synsedimentary rises developed within the Devonian, and persisted into the Carboniferous, in the undoubted autochthonous as well as in the supposed nappes. Thus the neritic rocks in the nappes are not alien to the area, and the main mass of the nappes, that are supposed to derive from a southern shelf beyond an oceanic realm, are pelagic greywackes with intercalated cherts.

The presently available arguments do not allow a boundary to be drawn between the autochthonous pelagic series and the supposed overthrusted neritic and pelagic nappes.