Geophysical Research Abstracts, Vol. 7, 02536, 2005
SRef-ID: 1607-7962/gra/EGU05-A-02536

The Archaean Eclogites of the Belomorian Province, the Fennoscandian Shield:

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Introduction According to the plate tectonic model, the formation of eclogites in the Phanerozoic orogenic belts was connected with deep subduction of crustal material followed by exhumation of some fragments during accretional and collisional processes. The absence of eclogites in geological complexes of the Archean age was put forward as one of restrictions for operation of plate tectonics in the Archean. It was assumed that due to the high geothermal gradient and relatively thin Earth crust the eclogites could not be formed. There are few references in the literature where the possibly Archaean eclogites are mentioned - in Scotland, (Alderman, 1936) and in Canada (Percival, 1994). But their ancient age was not confirmed by isotopic studies. The Archaean eclogites have been found and studied in the Belomorian Province of the Fennoscandian Shield (Volodichev et al., 2004). The Archaean eclogites and the products of their retrograde metamorphism are the components of polygenic migmatised mélange. Geological Overview The eclogite-containing complex makes up the tectonic plate dipping NE. It can be traced for more than 50 km being 6-7 km wide. The complex is composed of three main components: the relics of mélange matrics; rock fragments and various granitoids. The metamorphosed mélange matrics is represented by (Gr)-Bi-Amph-gneisses. The granitoids are represented by tonalities- trondjhemites, Qu-diorites, enderbites transformed into (Gr, Amph,)- Bi--gneisses. The fragmentary part of melange is composed of rocks different in composition, of different genetic nature, different age, and formed on different depths levels: eclogites, amphibolites, Ky-Gr-Bi gneisses, zoisites, metaultramfites and carbonates. The rocks of mafic composition prevail. They are represented by eclogites, highly reworked eclogites, amphibolites - garnet, garnet- clinipyroxene and feldspar-containing as well as gabbroids of different composition. The protolith of eclogite was basitic material comparable by petrochemical features with MORB and amphibo-

lites of the Central-Belomorian mafic zone. Petrography, Thermobarometry and P-T Evolution The eclogites are represented by biminaral paragenesis of garnet (22-30% Prp, 21-28 % Grs) and omphacite (28-40% Jd). The eclogites are usually preserved as relics among the garnet-clinopyroxene-plagioclase rocks with amphibole and quartz. The last have diablastic structure with symplectitic intergrowth of clinopyroxene and plagioclase. This shows their formation on eclogites during the later decompressional transformations. On the later stage the syplectitic eclogites transform into the banded garnet-clinoperexene and garnet amphibolites, and sometimes into feldspar amphibolites. The largest known up to now outcrop of eclogites and formed after them simplectitic apoeclogites and garnet amphibolites is situated in the south-west area of island Stolbikha among the amphibole-biotitic orthogneisses. It was here that the geochronological sample was taken. The eclogite consists of omphacite with 27-31% Jd, homogeneous garnet - 20-22% Prp (F=0.67-0.68) and accessory rutile. The symplectitic apoeclogite consists of zonal garnet with 23% Prp (F=0.67) in central and 18% Prp (F=0.74) in marginal zone and symplectic intergrowths of clinopyroxene with plagioclase of two generations - Di with 9% Jd + Pl - 43-49% An and Di with 6% Jd + Pl - 38-42% An. The garnet-clinopyroxene geothermometer (Powell, 1985) was used for the temperature determination and the Jd-isopleths (Holland, 1980) and garnet- clinopyroxene -plagioclase-quartz (Perkins, Newton, 1981) geobarometer to determine the pressure. At the prograde metamorphism the eclogites were formed at T=740-865°C and P=14.0-17.5 kbar. Four stages are distinguished in the trend of retrograde decompressional transformations, leading to formation of symplectic apoeclogites and garnet- clinopyroxen amphibolites. Geochronology The geochronological sample was taken from the main eclogite inclusion. The age of sepatrated zircons was determined by U-Th-Pb isotopic method on the ion microprobe. Zircons are represented by small, isometric, multifaceted grains, transparent, unzoned, colorless, and typical for growth under high-pressure conditions. The CL study has demonstrated the unzoned highly homogeneous structure of zircons. To confirm their genesis in eclogites the distribution of REE in zircons was determined on the ion microprobe. The results have confirmed their growth on the eclogitic stage. U-Th-Pb isotopic analyses were done on the ion microprobe Cameca 1270, NORDSIM at Swedish Museum of Natural History in Stockholm in the frame of NORDSIM project. The method applied followed that of Whitehouse at all, 1999. Nearly concordant data have been obtained with the best estimate age in 2720ś8 Ma. These results confirm the Archaean age of the studied eclogites. Conclusions The eclogites were found and studied inside the Belomorian province of the Fennoscandian shield. The eclogite-containing complex is represented by highly migmatitic mélange. The eclogites were preserved as relics among the symplectitic apoeclogites (eclogitic rocks) and garnet-clinipyroxene amphibolites. The protolith of eclogite was basitic material comparable by petrochem-

ical features with MORB and amphibolites of the Central-Belomorian mafic zone. The P-T conditions of eclogite formation on the stage of prograde development (P = 14.0-17.5 kbar, T = 740-865îñ) correspond to the depth up to 60-65 km in the environment where the processes of “warm” subduction could be developed. Trend of polistage subisotermic decompression with decreasing P from 13.0-14.0 up to 6.5 kbar at T = 770-650ñ reflects the process of subsequent exhumation. The age of these rocks was determined by zircon U-Th-Pb isotopic method on the ion microprobe and is equal to 2720ś8 ma. This is the first reliable finding of the Late Archaean crustal eclogites. The research was supported by RFBR, grants 03-05-65051 and 03-05-65010.

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