POLSKIE TOWARZYSTWO MINERALOGICZNE – PRACE SPECJALNE
MINERALOGICAL SOCIETY OF POLAND – SPECIAL PAPERS
Zeszyt 24, 2004; Volume 24, 2004

Sławomir ILNICKI[1], Anna ŚWIERCZEWSKA[2]

PRELIMINARY RESULTS OF PETROLOGICAL STUDY OF AMPHIBOLITE CLASTS FROM THE NEOGENE-PALEOGENE BASINS OF THE RED RIVER FAULT ZONE (NORTHERN VIETNAM)

Abstract: Clasts of amphibolite and metagabbro from sedimentary basins of Red River Fault Zone (RRFZ) were investigated for their provenance area. Composition of main minerals and geothermobarometric estimations yielded tentative PT path under amphibolite facies conditions: 645°C, 6.2kbar → 600°C, 5.4kbar and 580°C, 5.0kbar → 540°C, 4.2kbar for clasts of amphibolite and metagabbro, respectively. However, these results at present stage of research are not unequivocal due to affinity of the studied clasts to both Day Noi Con Voi and Precambrian amphibolites of the RRFZ.

Keywords: clasts, amphibolites, PT conditions, sedimentary basins, provenance area.

INTRODUCTION

The Red River Fault Zone (RRFZ) is a strike-slip zone, which separates Indochina and South China microplates. It is defined by NW-SE trending Tertiary metamorphic massifs up to about 20 km wide (Leloup et al. 1995). In Northern Vietnam RRFZ is delineated by the Day Nui Con Voi massif (DNCV), which comprises amphibolite facies paragneisses with minor mica schists, marbles and amphibolites. The DNCV massif is bound by two major faults: Red River Fault to the SW and Chay River Fault to the NE. The RRFZ is surrounded by Precambrian gneisses with amfibolite bodies and metasedimentary rocks to the SW and metasedimentary rocks to the NE (Tri 1973).

Sedimentary basins developed within the RRFZ in Northern Vietnam bear a record of uplift and denudation of the adjacent massifs. Small Paleogene-Neogene sedimentary basins occurring close to main faults are filled by alluvial and lacustrine deposits. Their origin is related to activity of the RRFZ (Wysocka, Świerczewska 2003), yet their sedimentary record is poorly understood. This paper presents preliminary results of petrological study conducted on amphibolite clasts collected in such basins. The principal aim of this study is determination of source regions of the clasts and reconstruction of tectonic activity of the area.

[1] *Warsaw University, Institute of Geochemistry, Mineralogy and Petrology, al. Żwirki i Wigury 93, 02-089 Warszawa, Poland; e-mail: ssi@geo.uw.edu.pl*
[2] *Institute of Geological Sciences, Polish Academy of Sciences, Research Centre in Cracov, Senacka 3, 31-002 Kraków, Poland, e-mail: ndswierc@cyf-kr.edu.pl*

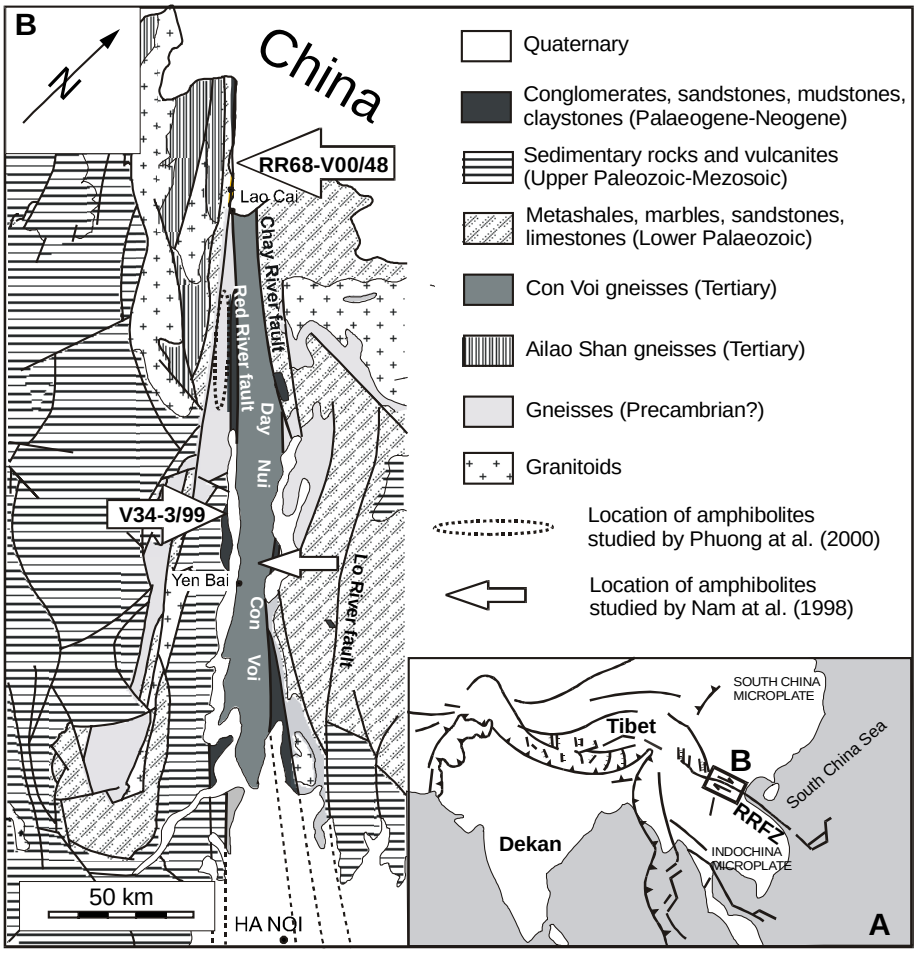

Fig. 1. **A.** Location of the Red River fault zone in SE Asia. **B.** Simplified geological map of the SE part of the RRFZ in Vietnam with location of studied samples (after Tri 1973).

METHODS AND RESULTS

Eighty four sites were sampled for the provenance studies in the basins located along all major faults of the RRFZ. However, clasts of amphibolites were found only in two exposures located SW to the Red River Fault. Minerals of the clasts were studied microscopically, then analysed by means of electron microprobe Cameca SX100. Chemical analyses of amphiboles were recalculated applying 13eCNK method.

The RR68-VOO48 sample is a granonematoblastic, fine-grained amphibolite with moderately developed foliation defined by dark- and light-minerals rich domains and further underlined by orientation of nematoblasts. The clast is composed mainly of amphibole, plagioclase and accessory quartz, sphene, apatite, ilmenite, allanite and zircon. Chlorite and biotite appear sporadically, replacing amphibole. Chemical composition of amphibole and plagioclase is quite varied and reveals chemical zoning within blasts. Cores of amphibole crystals are composed

of Fe-pargasite and Fe-tschermakite, whilst rims yield Fe- and Mg-hornblende composition (Fig. 2a). Plagioclase blast in cores are andesine (up to An_{40}) and in rims of oligoclase (An_{14-18}) or even albite composition (An_2).

The V34-3/99 sample is a granoblastic, fine-grained metagabbro with no metamorphic textures visible. The clast is composed of subhedral to anhedral blasts of plagioclase often twinned according to the albite law surrounded by blasts of

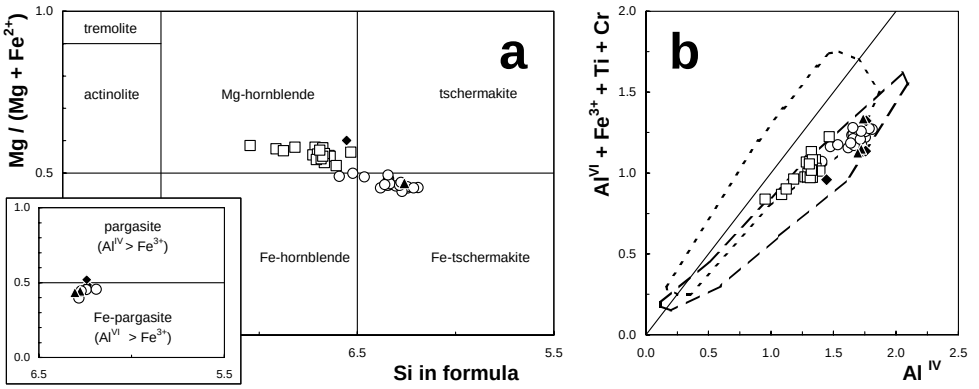

Fig. 2. **a**. Classification diagram (Leake et al. 1997) for the analysed amphibole crystals from the clasts: squares – amphiboles from the RR68-V00/48 sample, circles – amphiboles from the V34-3/99 sample, triangles and diamonds – amphiboles analysed by Nam et al. (1998) and Phuong et al. (2000), respectively. **b**. Variation diagram showing compositional changes within the analysed set of amphibole blasts; dotted and dashed lines denote position of amphiboles from the MP-MT metamorphic complexes of Dalradian and Haast River, respectively (after Laird, Albee 1981).

anhedral amphibole. Minor constituents of the rock are ilmenite, post-amphibole biotite and chlorite, quartz and sphene. Amphibole is composed of Mg-hornblende showing some chemical zoning: cores are more Al- and Fe-rich than rims (Fig. 2a). Plagioclase composition varies slightly yielding andesine composition ($An_{37\rightarrow42}$).

DISCUSSION AND CONCLUSIONS

Amphibole composition in favourable circumstances may serve as an indicator of metamorphic conditions to which a given rock has been subjected (e.g. Laird, Albee 1981, Schultz et al. 1995). Composition of the analysed amphiboles points to conditions which are typical of complexes that underwent metamorphism of medium pressures – medium temperatures (MP-MT, Fig. 2b). In the cases of the both samples PT conditions approximately correspond to amphibolite facies, however, it appears that amphiboles from the V34-3/99 sample were formed at rather lower temperatures and pressures due to lower concentrations of Si, Al^{IV}, Al^{VI}, Na and Ti. Application of amphibole geothermobarometer (Gerya et al. 1997) yielded the following PT conditions: for the RR68-VOO48 sample: 645°C, 6.2kbar $\rightarrow$ 600°C, 5.4kbar and for V34-3/99 sample: 580°C, 5.0kbar $\rightarrow$ 540°C, 4.2kbar

thus tentatively indicating that the both samples registered segment of amphibolite facies conditions of a clockwise PT-path of regional metamorphism.

The presented results do not unequivocally determine the source of the amphibolite clasts. The estimated conditions of the peak of metamorphism for the RR68-VOO48 sample lie within the error of PT conditions 690 (+30 to –60)°C, 6.5±1.5kbar (Nam et al. 1998) postulated for peak of metamorphism in the DNCV; even more, they are fairly similar to PT conditions if apply Gerya's et al. (*op. cit.*) geothermobarometer for amphibolites presently outcropping within the DNCV (635°C, 5.4kbar for data from Nam et al., *op. cit.*). On the other hand, they almost coincide with those calculated for the Precambrian amphibolites using amphibole data from Phuong et al. (2000; 650°C, 6.2kbar). Furthermore, the metagabbro clast (sample V34-3/99) could have been derived from the Precambrian amphibolites, where transition from gabbro to metagabbro was noted (Phuong et al. *op.cit.*).

The study was financed by the grants from the Committee of Scientific Research (KBN) no 2 P04D 04626 and the Faculty of Geology, Warsaw University no BW 1642/17.

REFERENCES

GERYA T.V., PERCHUK L.L., TRIBOULET C., AUDREN C., SER'KO A.I., 1997: Petrology of Tumanshet Zonal Metamorphic Complex, Eastern Sayan. Petrology, 5: 563-595.

LAIRD J., ALBEE A. L., 1981: Pressure, temperature, and time indicators in mafic schist: their application to reconstructing the polymetamorphic history of Vermont. Am. J. Sci. 281: 127-175.

LEAKE B., 1997: Nomenclature of amphiboles. Mineral. Mag. 61: 295-321.

LELOUP, P. H., LACASSIN, R., TAPPONNIER, P., SCHÄRER, U., DALAI, Z., XIAOHAN, L., LIANGSHANG, Z., SCHÄRER, U., DALAI, Z., XIAOHAN, L., TRINH, P. T. 1995: The Ailao Shan-Red River shear zone (Yunnan, China), Tertiary transform boundary of Indochina. Tectonophysics 251: 3-84.

NAM, T. N., TORIUMI, M., ITAYA T., 1998: P-T-t paths and post-metamorpic exhumation of the Day Nui Con Voi shear zone in Vietnam. Tectonophysics 290: 299-318.

PHUONG N.T., HOA T. T., ANH T.T., ANH P.L., 2000: Geochemical and Ar-Ar study on gabro from Proterozoic mafic-ultramafic complex in Fansipan-Red River uplif. Tap chi Cac Khoa Hoc Ve Trai Dat. 22: 399-409.

TRI, T. V. (ED.) 1973: Geological Map of Vietnam (the North Part). 1: 1 000 000. Geological Research Expedition No 45, Hanoi.

SCHULZ B., TRIBOULET C., AUDREN C. 1995: Microstructures and mineral chemistry in amphibolites from the western Tauern Window (Eastern Alps), and P-T deformation paths of the Alpine greenschist-amphibolite facies metamorphism. Mineral. Mag. 59: 641-659.

WYSOCKA A., ŚWIERCZEWSKA A., 2003: Alluvial deposits from the strike-slip fault Lo River Basin (Oligocene/Miocene), Red River Fault Zone, NW Vietnam. Journal of Asian Earth Sciences, 21: 1097-1112.