NGU
Norges geologiske undersøkelse
Geological Survey of Norway

GEOLOGY FOR SOCIETY

NGU Report 2007.057

Geodynamics, Geomagnetism and Paleogeography: A 50 Year Celebration

5.9 Perplexing Novaya Zemlya: the mystery of 700 Ma mafic intrusives cutting Devonian strata

F. Corfu[1], H. Svensen[1], S. Planke[2] and H.A. Nakrem[3]

[1]Department of Geosciences / PGP, University of Oslo; fernando.corfu@geo.uio.no, henrik.svensen@fys.uio.no
[2]VBPR, Oslo Research Park; planke@vbpr.no
[3]Natural History Museum, Oslo. h.a.nakrem@nhm.uio.no

A scientific expedition led by Olaf Holtedahl to Novaya Zemlya in 1921 brought back abundant scientific information and samples (Nakrem and Gradstein 2007). Later in the century some sectors of the islands were turned into nuclear testing grounds, rendering them next to inaccessible for geological field work. Because of this, the Holdedahl sample collection has become increasingly more valuable.

Our interest in samples of the Holtedahl collection stems from the work on the role played by large-scale mafic magmatic systems, which intrude sedimentary basins such a the North Atlantic or Karroo, and affect the climate by causing the release of significant quantities of greenhouse gases (e.g. Svensen et al. 2004). The report of mafic sills and dykes of likely Mesozoic age cutting fossiliferous Devonian strata in south-central Novaya Zemlya provided an opportunity to study well exposed rocks analogous to those present in the sedimentary basins of the Barents Sea.

Four gabbroic and dioritic samples from dykes cutting apparent Devonian sedimentary rocks in Matotchkin Strait and Mashigin Fiord were processed, analyzing zircon and titanite for U-Pb by the ID-TIMS technique. The results were unexpected as all four samples yield Late Precambrian ages, rather than the anticipated Mesozoic ages. Except for local inheritance linked to visible cores in zircon, there is no reason to believe that the populations could be xenocrystic. The zircon crystals are of uniform appearance with the long-prismatic and skeletal shapes typical of populations in mafic rocks and, in one sample, the zircon age is corroborated by that of coexisting titanite. The two samples from Mashigin Fjord yield slightly different ages of 716 ± 8 and 704 ± 5 Ma whereas those from Matotchkin Strait are identical at 707 ± 2 and 706 ± 14 Ma.

Although the new ages do not confirm the previously proposed chronostratigraphic position of the samples, they are not unreasonable when considered in their regional context. In fact Korago et al. (2004) have reported a similar age of ca. 700 Ma for the Mutushev granite, just north of Matotchkin Strait. That particular granite is overlain unconformably by Silurian strata (Korago et al. 2004) suggesting that the intrusives dated in our study may also fit in a similar basement –cover setting. The same authors reported zircon U-Pb ages of ca. 600 Ma for granites at Sulmenev Bay north of Mashigin Fiord, again confirming the presence of Vendian intrusives, this time cutting Mesoproterozoic basement. On a larger scale, the Neoproterozoic activity of Novaya Zemlya links up to events that had strong influence on the geology of the Uralian and west-Siberian regions. The 700-720 Ma put this activity ahead of the Timanian convergence and collision; its timing fits best with that of arc magmatism and ophiolites generation on the Siberian margin (e.g. Vernikovsky et al. 2003). The data are thus a very relevant contribution to the further development of the post-Rodinian Torsvikian continental reconstructions.

References

Holtedahl, O. 1924. On the rock formations of Novaya Zemlya. Report of the scientific results of the Norwegian expedition to Novaya Zemlya 1921 No. 22, 183 pp.

Korago, E.A., Kovaleva, G.N., Lopation, B.G. & Orgo,V.V. 2004. The Precambrian rocks of Novaya Zemlya. In Gee, D,G, & Pease, V.L. (eds.) The Neoproterozoic Timanide Orogen of Eastern Baltica. Geol. Soc. London Memoirs, 30, 135-143.

Nakrem, H.A. & Gradstein, F.M. 2007. Novaya Zemlya – the Holtedahl 1921 expedition and the valuable collection of rocks from an inaccessible part of the Russian Arctic. NGF Abstracts and Proceedings, no. 1, p. 67.

Svensen, H., Planke, S., Malthe-Sørenssen, A., Jamtveit, B., Myklebust, R., Eidem, T., & Rey, S. S. 2004. Release of methane from a volcanic basin as a mechanism for initial Eocene global warming. Nature 429, 542-545.

Vernikovsky, V.A., Vernikovskayaa, A.E., Kotov, A.B., Sal'nikova, E.B., & Kovach, V.P. 2003. Neoproterozoic accretionary and collisional events on western margin of the Siberian craton: new geological and geochronological evidence from the Yenisey Ridge: Tectonophysics 375, 147– 168.