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Some geochemical features of Caledonian volcanism recorded in sedimentary rocks of the East Baltic area

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The Caledonian rocks have formed as a result of a multitude of magmatic and tectonic processes. All these major processes have generated a set of volcanic and magmatic products. While products of intrusive magmatism can still be well recognised in Caledonian mountains, some of the volcanic products can be found in a wide area of the Baltica paleocontinent. The best record of the ancient explosive volcanism can be traced in sedimentary sections adjacent to tectonically active areas. The aim of this study is to describe geochemical evolution of the volcanism near the Baltica plate using bulk geochemistry and phenocryst compositions of the Caledonian volcanic ashes stored in the Lower Palaeozoic sections of the Eastern Baltica. The bentonite samples were collected from several drill cores from Estonia, Latvia and Lithuania. Thickness of the ash beds varies mostly between 0.1 and 10 cm, rarely reaching 20–70 cm. Constructed isopach schemes indicate increase of thickness of ash beds towards the northwest and west. Original sanidine composition in ca 400 samples and biotite from 13 ash beds were analysed from grain fraction of bentonites using X-ray diffractometry.

Stratigraphical distribution of volcanic ash beds in the East Baltic area can be subdivided into four major intervals separated by intervals with less frequent signs of volcanism. The above intervals show characteristic geochemical signatures. Over 175 thin altered volcanic ash beds have been recognised by authors in the East Baltic sedimentary sections from the Upper Ordovician (ca. 458 Ma) to the Upper Silurian (ca. 421 Ma). There separate ash units may correspond to distinct volcanic eruptions in Caledonides.

Volcanic ashes which reached the East Baltic area fall into four time periods (time intervals distinguished by micro-paleontological methods): (1) Sandbian with main sources at the margins of the Avalonian microcontinent; (2) Katian with sources at the margin of the Baltica in Iapetus Palaeo-Ocean (Norwegian Caledonides); (3) Aeronian with probable sources in the Central European Caledonides and (4) From Telychian to lower Ludlow with sources within the closing Iapetus Palaeo-Ocean. Considering the trace element composition and sanidine systematics, the most dominating magmas were evolved magmas with rhyolitic and dacitic compositions.

The magmatic-volcanic periods differ by volcanic source regions and geochemical composition. For example, an interval of very intensive volcanism, lasting ca 15 Ma and characterised by ca 140 ash beds (eruptions) falls into the early Ludlow. In Telychian Stage, seven geochemical groups of ashes, probably representing different source volcanoes, have been divided. The products include a quartz-rich, Zr-, Nb-, Sr-, Th-enriched and other varieties. The Aeronian period is characterized by less evolved source magmas of andesitic, tracyandesitic and basaltic composition. There is a strong evidence for carbonatitic volcanic eruption in this period.