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The origin of the Palaeoproterozoic AMCG complexes in the Ukrainian shield: New U-Pb ages and Hf isotopes in zircon



Leonid Shumlyanskyy^{a,*}, Chris Hawkesworth^{b,c}, Kjell Billström^d, Svetlana Bogdanova^{e,j}, Oleksandr Mytrokhyn^f, Rolf Romer^g, Bruno Dhuime^c, Stefan Claesson^d, Richard Ernst^{h,i}, Martin Whitehouse^d, Olena Bilan^f

^a M.P. Semenenko Institute of Geochemistry, Mineralogy and Ore Formation, Palladina Ave., 34, 03680 Kyiv, Ukraine

^b Earth and Environmental Sciences, University of St. Andrews, College Gate, North Street, St. Andrews, KY16 9AJ, UK

^c Department of Earth Sciences, University of Bristol, Queen's Road, Bristol BS8 1RJ, UK

^d Department of Geological Sciences, Swedish Museum of Natural History, Box 50007, SE-10405 Stockholm, Sweden

^e Department of Geology, Lund University, Sölvegatan 12, SE 223 62 Lund, Sweden

^f Department of Geology, Kyiv Taras Shevchenko National University, Vasylykivska St., 90, 03022 Kyiv, Ukraine

^g GFZ German Research Centre for Geosciences, Telegrafenberg, Building B, 14473 Potsdam, Germany

^h Department of Earth Sciences, Carleton University, Ottawa, Ontario, Canada

ⁱ Faculty of Geology and Geography, Tomsk State University, 36 Lenin Ave, Tomsk 634050, Russia

^j Kazan Federal University, Kazan, Russia

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ABSTRACT

The Ukrainian shield hosts two Palaeoproterozoic anorthosite-mangerite-charnockite-granite (AMCG) complexes (the Korosten and Korsun-Novomyrhorod complexes) that intruded Palaeoproterozoic continental crust in north-western and central parts of the shield, respectively. We report results of U-Pb zircon and baddeleyite dating of 16 samples from the Korosten plutonic complex (KPC), and 6 samples from the Korsun-Novomyrhorod plutonic complex (KNPC). Fifteen zircon samples from both complexes were also analysed for Hf isotopes. These new, together with previously published data indicate that the formation of the KPC started at c. 1815 Ma and continued until 1743 Ma with two main phases of magma emplacement at 1800–1780 and 1770–1758 Ma. Each of the main phases of magmatic activity included both basic and silicic members. The emplacement history of the KNPC is different from that of the KPC. The vast majority of the KNPC basic and silicic rocks were emplaced between c. 1757 and 1750 Ma; the youngest stages of the complex are represented by monzonites and syenites that were formed between 1748 and 1744 Ma. Both Ukrainian AMCG complexes are closely associated in space and time with mantle-derived mafic and ultramafic dykes. The Hf isotope ratios in the zircons indicate a predominantly crustal source for the initial melts with some input of juvenile Hf from mantle-derived tholeiite melts.

The preferred model for the formation of the Ukrainian AMCG complexes involves the emplacement of large volumes of hot mantle-derived tholeiitic magma into the lower crust. This resulted in partial melting of mafic lower-crustal material, mixing of lower crustal and tholeiitic melts, and formation of ferromonzodioritic magmas. Further fractional crystallization of the ferromonzodioritic melts produced the spectrum of basic rocks in the AMCG complexes. Emplacement of the ferromonzodioritic and tholeiitic melts into the middle crust and their partial crystallization caused abundant melting of the ambient crust and formation of the large volumes of granitic rocks present in the complexes.

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1. Introduction

The origin of anorthosite-mangerite-charnockite-granite (AMCG) complexes is one of the more intriguing problems of mod-

ern petrology. The main aspects include the origin and nature of the initial melts, and the relationships between silicic and basic members of the AMCG associations. Different researchers have proposed models in which the initial source was in the mantle (Ashwal et al., 1986; Ashwal, 1993; Emslie and Hegner, 1993; Scoates and Frost, 1996; Frost and Frost, 1997; Gleibner et al., 2011) or in the lower crust (Taylor et al., 1984; Schärer et al.,

* Corresponding author.

E-mail address: lshumlyanskyy@yahoo.com (L. Shumlyanskyy).