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Timing of Palaeoproterozoic intra-orogenic sedimentation in the central Fennoscandian Shield; evidence from detrital zircon in metasandstone

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Abstract

Detrital zircon U–Pb SIMS data on quartz-rich metasandstone units presumed to belong to the upper part of the Svecofennian stratigraphy in southeastern Finland and east-central Sweden suggest the existence of clastic sedimentary basins between the two main orogenic phases at 1.89–1.86 Ga and 1.83–1.79 Ga, during a period referred to as the intra-orogenic phase (1.86–1.83 Ga).

Stratigraphically below the metasandstone at Hamrånge, east-central Sweden, is a metadacite with an U–Pb zircon TIMS age of 1888 ± 6 Ma, which indicates the maximum age of sedimentation. It also indicates that an earlier proposed correlation of Hamrånge metavolcanic rocks and 1.86 Ga equivalents at Los to the northwest must be rejected. Instead, there is a temporal affinity to the metavolcanic rocks in the Bergslagen Province to the south or Southern Finland to the east.

Quartz-rich metasandstone samples from four localities, Luukkola, Pyhäntaka and Tiirismaa in Finland and Hamrånge in Sweden, yield multimodal detrital zircon age distributions with main populations at 2.95–2.60 Ga, 2.10–1.95 Ga and 1.92–1.85 Ga. The groups are similar in all four samples, and they are comparable to previously reported detrital ages in this part of the Fennoscandian Shield. The oldest zircon analysed gave an age of 3.32 Ga (Tiirismaa).

The maximum ages of sedimentation (and of subsequent deformation and metamorphism), indicated by the youngest detrital zircon**,** from the four localities are 1842 ± 10 Ma (Luukkola), 1865 ± 11 Ma (Pyhäntaka), 1848 ± 13 Ma (Tiirismaa), and 1855 ± 10 Ma (Hamrånge), respectively. Possible source rocks for these zircon grains are found within and around the vast Ljusdal Batholith in Sweden, and in the Arc Complexes of Western and Southern Finland. It is concluded that several intra-orogenic sedimentary basins existed during the time interval 1.86–1.83 Ga ago, between two major orogenic events in the Fennoscandian Shield.

Keywords: Fennoscandian Shield; Palaeoproterozoic; Detrital zircon; Provenance; U–Pb; SIMS

1. Introduction

The central part of the Fennoscandian Shield (Fig. 1A) is dominated by Palaeoproterozoic rocks modified during the Svecokarelian (Rankama and Welin, 1972) or Svecofennian (e.g. Gaál and Gorbatschev, 1987) orogeny. Recently Lahtinen et al. (2005) subdivided this composite orogeny into four orogenies (Lapland-Savo, Fennian, Svecobaltic and Nordic). They also suggested that an extensional episode, here called the intra-orogenic stage, occurred between the Fennian and Svecobaltic orogenies.

Evidence for early-orogenic ca. 1.89–1.87 Ga deformation and metamorphism (Fennian orogeny) is abundant in the Arc Complexes of Western and Southern Finland (Fig. 1A); also in parts of central Sweden such evidence has recently emerged (Andersson et al., 2004, 2006; Hermansson et al., 2006; Högdahl

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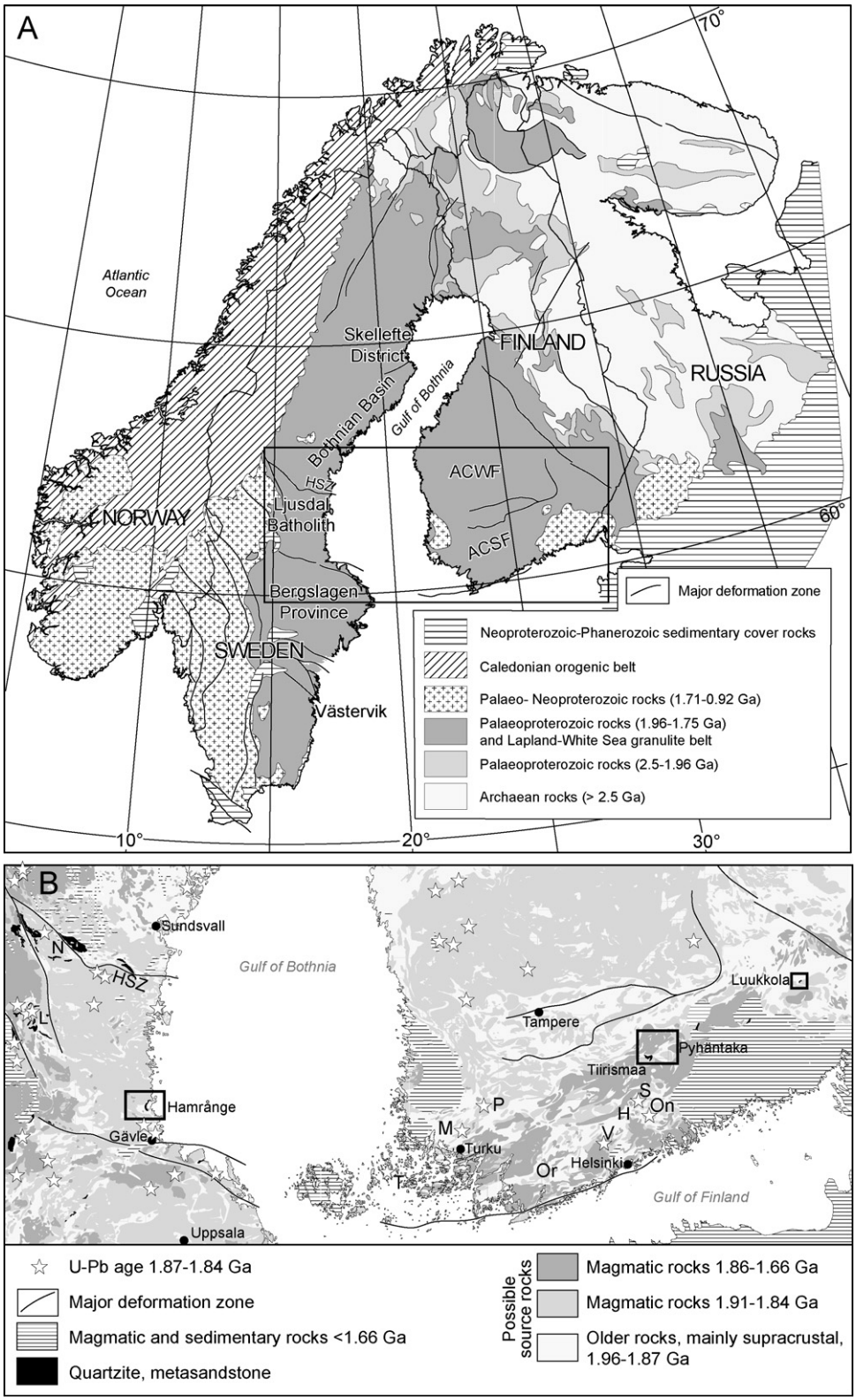

Fig. 1. (A) Bedrock map of the Fennoscandian Shield, modified from Koistinen et al. (2001). ACWF: Arc Complex of Western Finland, ACSF: Arc Complex of Southern Finland and HSZ: Hassela Shear Zone are referred to in the text. (B) Bedrock map of south-central Sweden and Southern Finland, modified from Koistinen et al. (2001). Study areas shown in Fig. 2 are indicated. Stars denote locations of 1.87–1.84 Ga U–Pb ages of plutonic rocks, from Nironen (2003), Hermansson et al. (2006), Bergman and Söderman (2005), Bergman et al. (2005) and the Geological Survey of Sweden age database. Localities referred to in the text: H: Hyvinkää, L: Los, M: Masku, N: Naggen, Or: Orijärvi, On: Onkimaa, P: Pöytyä, S: Soukkio, T: Torsholma, V: Veikkola.