

U-Pb zircon TIMS age of a K feldspar augen-bearing, early-orogenic Svecokarelian granite west of Ramnäs, Sweden

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SAMMANFATTNING

Berggrunden i området som motsvaras av topografiska kartbladet 11G Västerås NV (enligt Lantmäteriets RT 90-nät) domineras av intrusiva bergarter av två generationer (fig. 1; Bergman m.fl. 2001, 2002; Ripa & Kübler (2005). Den äldre generationen tillhör den så kallade GDG-sviten (se Stephens m.fl. 2009 för nomenklatur; även kallad svekokarelskt tidigorogen i äldre litteratur), den yngre generationen tillhör den så kallade GP-sviten (kallad svekokarelskt serorogen i äldre litteratur). I allmänhet är GDG-bergarterna metamorfa och deformerade i olika grad, medan GP-bergarterna inte är det. Lokalt förekommer emellertid deformerade bergarter som för övrigt till synes tillhör den yngre generationen.

Vid reguljär kartering under fältsäsongen 2000 i ett område väster om Ramnäs dokumenterades ett antal hållar med en kalifältspatporfyrisk och folierad till gnejsig granit till granodiorit. Den tektoniska strukturen i bergarten stryker nordost-sydvästligt. I omgivande hållar finns odeformerade bergarter med likartat utseende som ser ut att tillhöra GP-sviten. Den deformerade bergarten torde alltså antingen representera en GDG-bergart eller en deformerad GP-bergart.

För att avgöra denna fråga gjordes en datering med hjälp av U-Pb-metoden i zirkon. Vid denna tid gjordes analyserna fortfarande med TIMS-teknik. Av olika anledningar har resultatet tidigare inte publicerats, men ett preliminärt resultat angavs på berggrundskartan av Ripa & Kübler (2005).

Åldersbestämningen visar att bergarten kristalliserade vid 1907 ± 7 Ma (miljoner år sedan) och därför tillhör GDG-sviten. Den är en av de äldsta hittills daterade GDG-bergarterna i Bergslagen (se Stephens & Jansson 2020).

INTRODUCTION

The bedrock in the area corresponding to mapsheet 11G Västerås NV (Swedish national RT 90 grid, cf. www.lantmateriet.se) is dominated by intrusive rocks, which belong to two rock suites of different ages and geneses (fig. 1; Bergman et al. 2001, 2002). In general, rocks of the older of the two suites are variably deformed and metamorphosed, whereas rocks of the younger suite are not. Locally, however, the younger rocks may be deformed. In some cases, where a rock is strongly deformed, but still has the appearance of that of a younger, the interpretation of which suite the rock actually belongs to is hard to make.

During regular mapping in 2000 in an area west of the village of Ramnäs (fig. 1), a K feldspar augen-bearing, foliated to gneissic, granitic to granodioritic rock was encountered in a couple of outcrops. The strike of the tectonic foliation is northeast-southwest. To the northwest and southeast, K feldspar porphyritic, undeformed granites to granodiorites outcrop. The undeformed rocks appear to belong to the younger suite of rocks. The deformed rock may thus either represent a sheared variety of the latter or the older suite.

In order to solve the problem, we decided to date a sample of the deformed rock. For various reasons the result has previously not been properly reported; a preliminary age was published on the bedrock map by Ripa & Kübler (2005).

REGIONAL GEOLOGY

The rocks in the area are typical of a major part of the bedrock of the Bergslagen region in southern Sweden, which is part of the Baltic Shield (Stephens et al. 2009; Stephens & Jansson 2020). The oldest recognised rocks belong to a Palaeoproterozoic, c. 1.9 Ga (Lundström et al. 1998), metamorphosed volcano-sedimentary succession (Svecofennian), informally known as the "leptite formation" (e.g. Magnusson 1936). The metasupracrustals consist dominantly of rhyolitic volcanic, subvolcanic and volcanoclastic rocks deposited in a submarine environment (Oen et al. 1982; Van der Welden et al. 1982; Lundström 1987; Allen et al. 1996). Subordinate intermediate and mafic volcanic rocks together with chemical, epiclastic and organogenic sediments occur at different stratigraphic levels of the volcanic pile. Abundant mineral occurrences (iron oxide and base metal sulphides) are hosted by skarn-altered carbonate rocks interlayered with volcanogenic ash-siltstone strata. The clastic metasedimentary rocks include argillites, greywackes, quartzites and conglomerates (Lundström 1995).

The supracrustals were intruded by largely synvolcanic ("older", early-orogenic Svecokarelian), c. 1.9 to 1.85 Ga (Welin et al. 1980; Åberg et al. 1983a, b; Åberg & Strömberg 1984; Persson 1993; Persson & Persson 1997, 1999; Ripa & Persson 1997) ultramafic to granitic plutonic rocks and mafic dykes, younger (syn- to postorogenic Svecokarelian) plutonic rocks, and late (anorogenic Svecokarelian), c. 0.95 Ga (Patchett 1978) dolerites. The younger plutonic rocks consist of c. 1.81 to 1.75 Ga (Åberg & Bjurstedt 1986; Patchett et al. 1987; Billström et al. 1988; Stephens et al. 1993; Sundblad et al. 1993; Bergman et al. 1995; Ivarsson & Johansson 1995; Öhlander & Romer 1996; Persson & Persson 1997) anatectic, I- and S-type granites formed during peak metamorphism and of partly more or less coeval (c. 1.86 to 1.68 Ga; Persson & Wikström 1993; Wikström 1996; Jarl & Johansson 1988, Persson & Ripa 1993; Stephens et al. 1993; Andersson 1997; Lundqvist & Persson 1999; Lindh et al. 1994; Ahl et al. 1997, 1999) plutonic rocks of TIB-type, which formed a differentiated, syenitoid suite with alkali-calcic affinity (e.g. Ripa 1998). The supracrustal rocks, the older plutonic rocks and the mafic dykes were deformed and metamorphosed at varying grades during the Svecokarelian orogeny (Lundqvist 1979). Mesoproterozoic and Phanerozoic sedimentary rocks are present in some areas.

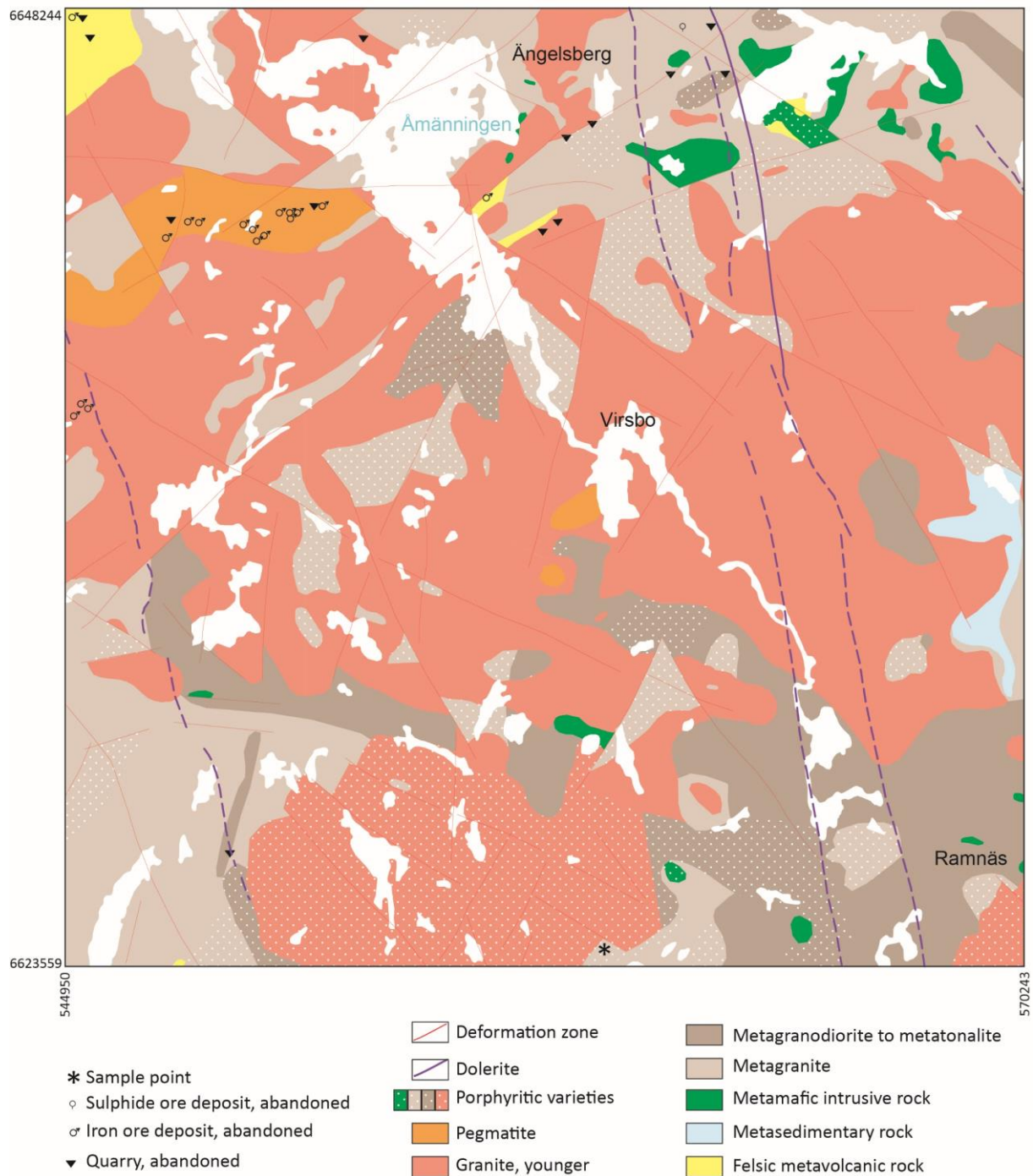


Figure 1. Simplified geological map, 11G Västerås NV (modified from Bergman et al. 2002). Hatched symbol for dolerites means only geophysically indicated. Coordinates according to SWEREF 99TM.

LOCAL GEOLOGY

As mentioned above, the area west and north of Ramnäs is dominated by intrusive rocks (fig. 1). Representatives of the oldest supracrustal rocks occur north of Ramnäs and in the northwestern corner of the area indicated in figure 1. The metamorphic grade in these rocks is upper amphibolite facies, and their interpretation and classification are not always certain. Three units of variably evolved older intrusive rocks are indicated in figure 1. They are metagranites, metagranodiorite to metatonalites and metamafic rocks. The most abundant rock type in the area is younger, anatectic I- to S-type granite. The latter locally grade into pegmatitic granite and pegmatite. A few northnorthwest trending dolerite dykes are shown in figure 1. All igneous rocks except the dolerites are locally porphyritic.

The Svecofennian supracrustal rocks and the older metaintrusive rocks are generally deformed. The younger granites are locally deformed in a manner which suggest that much of the deformation seen in the older rocks is synmetamorphic. In addition, all rocks except the dolerites are cut by later, discrete, ductile to brittle deformation zones.

SAMPLE PREPARATION AND ANALYSIS

A sample of a foliated to gneissic, K feldspar augen-bearing metagranite to metagranodiorite was taken from an outcrop at location 6623600/558845 (sweref 99 TM; fig. 1).

The isotope analyses were performed according to the TIMS method described in "Editors preface" in Bergman (2002).

DESCRIPTION OF ZIRCONS

The zircons are colourless to pale brown and the length/width ratio is generally 2–5. The majority of the grains are euhedral with sharp edges and pyramid tips but slightly rounded grains are also present. The crystals have virtually only low-order crystallographic indices. Only a small portion of the separated zircons are transparent and non-metamict and almost all of them contain small, black inclusions. Many grains show a weak magmatic zonation. The zircon crystals selected for analysis were colourless, pale pink och pale brown and were thoroughly abraded. Fractions 1 and 3 are elongated whereas 2 and 4 are short prismatic.

RESULTS

The results of the zircon analyses are summarised in Table 1 and figure 2.

The data points are slightly discordant and the spread along the discordia is rather limited. The intercept ages are 1907 ± 7 and 348 ± 200 Ma, respectively, and the MSWD is 1.3. The upper intercept age is interpreted as the crystallisation age of the granite.

The sampled rock is thus among the oldest examples of dated early-orogenic Svecokarelian granitoids in the Bergslagen region (see Stephens & Jansson 2020).

Table 1. U-Pb isotopic data.

Analysis No.	Weight (µg)	No. of crystals	U (ppm)	Pb tot. (ppm)	Common Pb (ppm)	$\frac{^{206}\text{Pb}^*}{^{204}\text{Pb}}$	$\frac{^{206}\text{Pb}}{^{207}\text{Pb}} / \frac{^{208}\text{Pb}}{^{206}\text{Pb}}$ Radiog. (atom %)**	$\frac{^{206}\text{Pb}^{**}}{^{238}\text{U}}$	$\frac{^{207}\text{Pb}^{**}}{^{235}\text{U}}$	$^{207}\text{Pb}/^{206}\text{Pb}$ age (Ma)
1	11.9	5	244.0	85.4	0.19	13282	79.8 / 9.3 / 10.9	0.3239 ± 19	5.185 ± 31	1897 ± 2
2	9.0	8	211.4	71.7	0.04	20837	81.1 / 9.4 / 9.5	0.3198 ± 14	5.103 ± 24	1891 ± 4
3	11.7	1	134.6	47.6	0.01	18388	79.4 / 9.2 / 11.4	0.3268 ± 18	5.228 ± 32	1896 ± 4
4	13.6	4	191.7	66.3	0.08	16857	82.1 / 9.6 / 8.3	0.3297 ± 13	5.283 ± 22	1899 ± 2

* Corrected for mass fractionation (0.1% per a.m.u) and spike.

** Corrected for mass fractionation, spike, blank and common Pb.

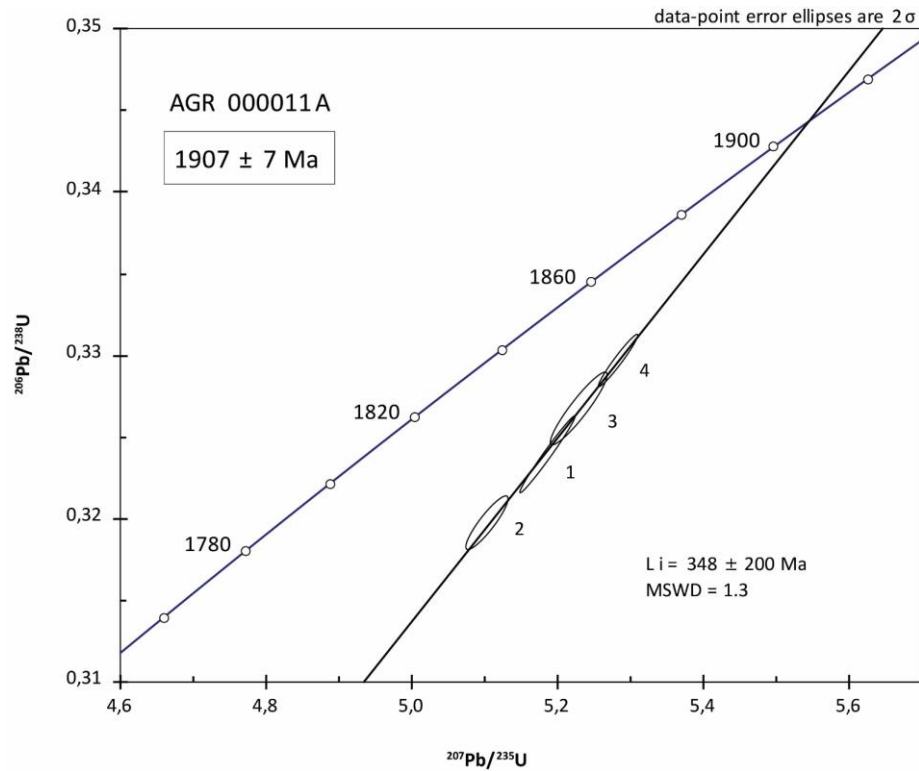


Figure 2. Concordia diagram for analysed zircons from the granitoid sample west of Ramnäs.

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