

ISOTOPIC AGE DETERMINATIONS IN BERGSLAGEN, SWEDEN: I. INTRODUCTION¹I. S. OEN² & R. H. VERSCHURE³

Oen, I. S. & R. H. Verschure 1982 Isotopic age determinations in Bergslagen, Sweden: 1 Introduction
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The Filipstad-Grythyttan-Hjulsjö region, West Bergslagen (Fig. 1), is a part of the 2.2-1.5 Ga Svecokarellides of central Sweden (WELIN, 1970; LUNDQVIST, 1979). The region is built of a supracrustal volcano-sedimentary series that is folded, metamorphosed and intruded by basic and granitic rocks.

The Supracrustal Series is divided by SUNDIUS (1923) and MAGNUSSON (1925) in a lower Volcanic Division with a lower stage of sodic and an upper stage of potassic leptytes and hällflintas, and an upper Sedimentary Division with banded hällflintas and metagreywackes overlain by black and grey slates (Table I). Leptytes are fine-grained and hällflintas extremely fine-grained quartzofeldspathic, mostly metavolcanic rocks. The leptytes and hällflintas of the Volcanic Division contain intercalations of marbles, quartzites and skarns with Fe-, Mn- and sulfide-ores. The Sedimentary Division is confined to the NNW synclinal structures of Saxån and Grythyttan (Fig. 1). Near Grythyttan the slate and older formations are locally discordantly overlain by conglomerates. Conglomeratic and quartzitic formations also occur in a small area NW of Nordmark. The Saxån and Grythyttan metasediments contain metaspilite and metabasalt intercalations; metabasic sheets and dikes considered as intrusive equivalents of the spilites and basalts are referred to as Older Greenstones by SUNDIUS (1923) and MAGNUSSON (1925). The steeply dipping supracrustal strata show a predominant NNW strike, but in some areas an E-W strike is characteristic. Mesoscopic folds, mostly with steeply NW or NNW plunging axis, are observed in marbles, skarns and other layered formations. A regional subvertical NNW schistosity and steep

lineation characterize the Saxån and Grythyttan slates and the leptytes and hällflintas in certain NNW schistose or foliated zones. Deformation was accompanied by low-grade regional metamorphism. Greenschist facies metasediments and meta-volcanics are preserved in the Grythyttan-Hjulsjö area; to the west and east amphibolite facies rocks predominate, but the high-grade metamorphism is generally attributed to the action of granitic intrusions.

The oldest granites are the 'Urgraniter' or Older Granites, which form large massifs spread over central Sweden. However, in West Bergslagen Older Granites form only minor intrusions, the largest of which is the about 15 by 6 km large Horssjö granite N of Filipstad. The Horssjö granite varies from massive to strongly foliated and shows granophyric border facies. MAGNUSSON (1925), 1970) has ascribed much of the high-grade metamorphism, Mg-metasomatism and sulfide mineralization in the Nordmark, Persberg and Långban districts to the action of the Horssjö granite. In the Grythyttan-Hjulsjö area smaller stocks of Older Granites consist of massive biotite granites and granitic granophyres.

According to MAGNUSSON (1925, 1970) the emplacement of Older Granites was followed by that of Younger Greenstones and by a regional subsidence. The Younger Greenstones cut through Older Granites, but otherwise they are petrographically similar to the Older Greenstones. Subsequent to regional subsidence three groups of Younger Granites were emplaced.

(1) The Grängen and other granites E of Hjulsjö belong to the Fellingsbro Group, which forms large batholiths in the Fellingsbro-Malingsbo region further eastward.

(2) The Filipstad granites belong to the Värmland Group, which forms a segment of a NNW granite belt from Småland in SE Sweden, across E Värmland, to beyond the Norwegian border in N Värmland; this granite belt separates the leptyte

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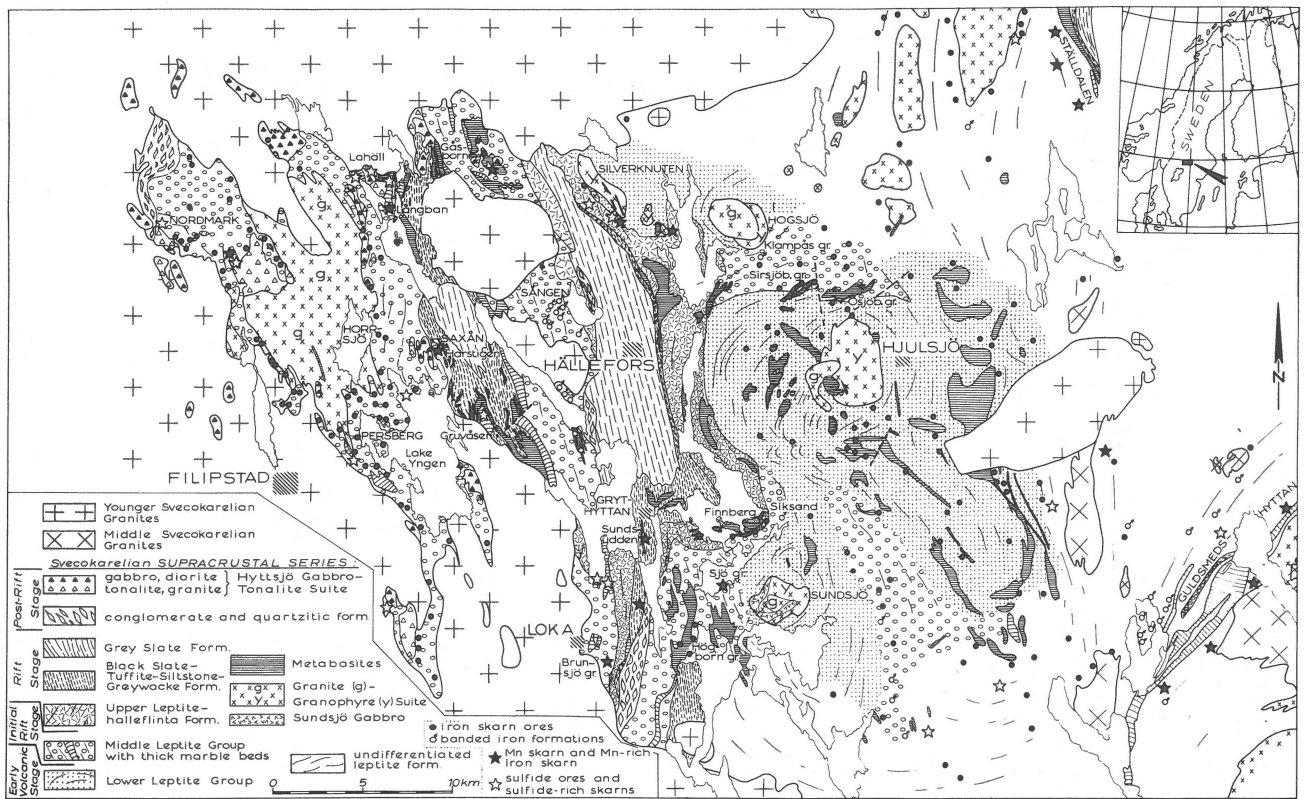


Fig. 1. Geological sketch map of the Filipstad-Grythyttan-Hjulsjö region (after Oen et al., 1982).

region of Bergslagen from the gneiss region of SW Sweden (LUNDQVIST, 1979; GORBATSCHEV, 1980). A differentiated suite of so-called Hyttsjö diorites and granites is considered by MAGNUSSON (1925, 1970) as related to the Filipstad granites.

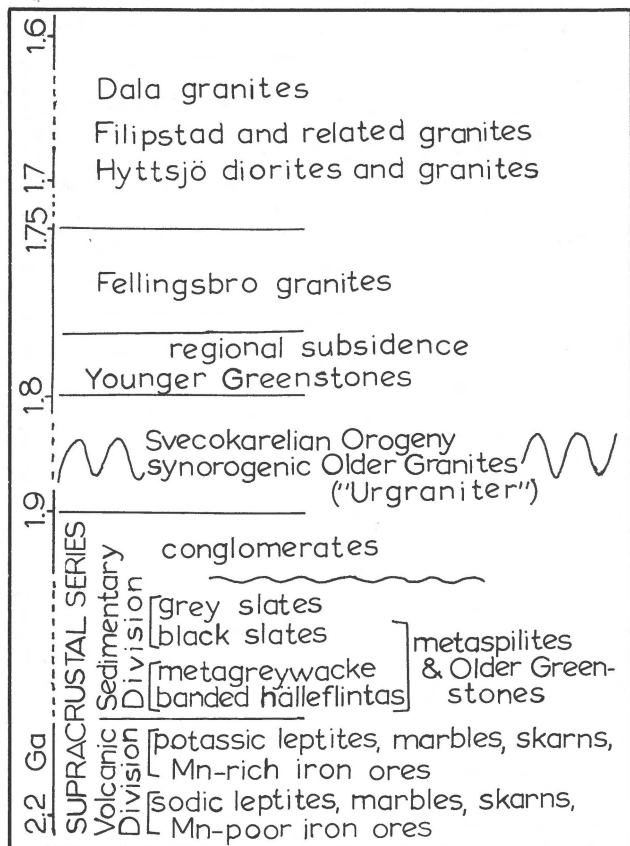
(3) The granites N of the Grythyttan area belong to the Dala Group, which has its greatest extension in Dalarna, where they form the northern segment of the belt of Småland-Värmland granites.

The Younger Granites and older rocks are traversed by younger shear zones and NNW dolerite dikes.

It is widely assumed that the Svecokarelian supracrustals were deposited 2.2.-1.9 Ga ago and were folded and intruded by synorogenic 'Urgraniter' during the Svecokarelian Orogeny, which according to age data of 'Urgraniter' in SE and N Sweden occurred 1.9-1.8 Ga ago; the Fellingsbro granites are generally correlated with the 1.8-1.75 Ga Revsund and other granites in N Sweden; the Filipstad and other Värmland and Småland granites have been dated at 1.7-1.6 Ga and the Dala granites at 1.64 Ga (WELIN, 1979; LUNDQVIST, 1979). The younger dolerites belong to a 1000-850 Ma, Sveconorwegian dike swarm (PATCHETT, 1978). Table I shows the prevailing view on the geology of the Filipstad-Grythyttan-Hjulsjö region. However, recent work (OEN ET AL., 1982) has provided a new insight in the stratigraphy and geotectonic setting of this segment of the Svecokarelidés.

OEN ET AL. (1982) define the Bergslagen Supracrustal Series as a 1.9-1.8 Ga chronostratigraphic unit divided into four stages (Table II). The Early Volcanic Stage comprises the Lower Leptite Group (corresponding largely to the sodic leptites of SUNDIUS, 1923), which is deposited in the oldest volcanic complexes (VAN DER VELDEN ET AL., 1982). The Initial Rift Stage comprises the Middle Leptite Group (corresponding to parts of the sodic and potassic leptites of SUNDIUS, 1923, and MAGNUSSON, 1925), which is deposited in broad, shallow N-S and E-W basins. The Rift Stage comprises the Upper Leptite-hälleflinta and Slate Group, represented by the potassic leptite-hälleflintas and the sedimentary sequence along and in the NNW rift basins of Saxån and Grythyttan. The Rift Stage is characterized by bimodal acid-basic magmatism ascending along NNW rift fractures. Acid magmas gave rise to the Upper Leptite-hälleflinta Formation, which shows lateral interfingering with the lower sedimentary formations of the Grythyttan basin. Basic magmas gave rise to spilites and basalts in the lower basin-filling formations and to a system of mostly NNW basic dikes and sheets. The Lower and Middle Leptite Groups, e.g. in the Hjulsjö area, were intruded by the same system of basic dikes and sheets, acid and composite acid-basic dikes, granite and granophyre stocks; the granitic stocks cut across some, but are cut by other basic dikes. In fact, SUNDIUS' (1923) and MAGNUSSON'S (1925) Older and Younger Greenstones were both emplaced coeval with the ascend of granitic magmas into their earlier volcanic

Table I
Stratigraphic table of the Filipstad-Grythyttan-Hjulsjö region according to Sundius (1923) and Magnusson (1925, 1970) and adapted to Welin's (1970) geochronological scheme.

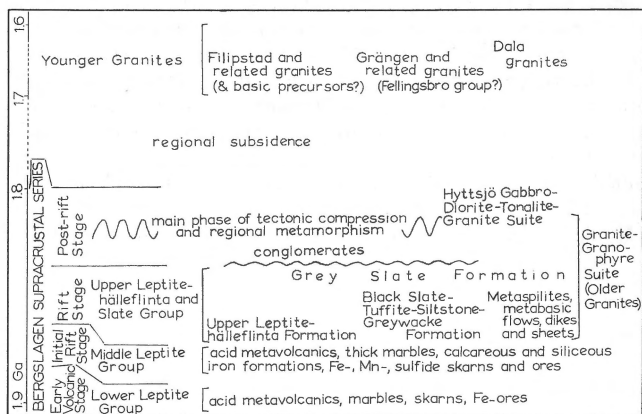


pile. The granitic magmas consolidated as Older Granites during the Rift Stage or persisted as unconsolidated magma (e.g. the Horssjö granite magma) until in the Post-rift Stage. The Rift Stage ended with cessation of volcanism, vertical movements and emergence. Conglomerates and other sediments were deposited in local Post-rift basins. The Post-rift Stage is characterized by epicrustal compressive tectonic events causing shear folding and flattening of the rocks in the rift basins and in certain shear zones. The Horssjö granite was involved in shearing and consolidated as a protoclastically foliated granite in the Post-rift Stage. Horssjö granite, shear zones and deformed rift basins are intruded by Hyttsjö gabbro-diorite and tonalite-granite stocks and dikes. Net-veined synplutonic Hyttsjö diorite dikes in the Horssjö granite suggest a Post-rift Stage emplacement of the Hyttsjö suite of rocks.

Table II is consistent with recently published age data (WELIN ET AL., 1977, 1980) and age determinations by the Z. W. O.-Laboratorium voor Isotopen Geologie, Amsterdam, which suggest that

(1) the Younger Granites in the Filipstad-Grythyttan-Hjulsjö region, including the Fellingsbro-type Grängen granite, were emplaced 1.7-1.6 Ga ago

Table II
Stratigraphic table of the Filipstad-Grythyttan-Hjulsjö region as proposed by Oen et al. (1982) and in this paper.



(2) the rocks of the Supracrustal Series (Table II) were emplaced, deformed and metamorphosed 1.9-1.8 Ga ago.

According to OEN ET AL. (1982) the paleo-environment of the Bergslagen Supracrustal Series may be that of a 1.9-1.8 Ga Proterozoic aulacogen. Incipient rifting caused formation of volcano-sedimentary basins in which ore deposits were formed by exhalative-sedimentary and seafloor hydrothermal-metamorphic processes in connection with the acid and basic magmatism during the Initial Rift and Rift Stages. The deposits were modified by Post-rift Stage and later, post-Supracrustal Series, deformation and metamorphism.

This paper is an introduction to a series of short communications 'Isotopic age determinations in Bergslagen, Sweden', which will be submitted to this journal. An earlier paper on K-Ar ages of hornblendes in skarns and metabasites in the Hjulsjö area has been published elsewhere (MOORMAN ET AL., 1982). This joint research project of the ZWO-Laboratory of Isotope Geology and the Geological Institute University of Amsterdam forms part of the research program of the 'Stichting voor Isotopen-Geologisch Onderzoek', supported by the Netherlands Organization for the Advancement of Pure Research (Z.W.O.).

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