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Short Note on a Thorium-rich Granite in the Three Corner Area (Dreiländereck) of Austria, the Czech Republic and Germany

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2 Text-Figures, 1 Table

Österreichische Karte 1 : 50.000
Blätter 2, 3, 13, 14

Oberösterreich
Böhmische Masse
Plöckenstein-Granit
Radioaktivität

Inhalt

Kurze Notiz über einen thoriumreichen Granit im Dreiländereck Österreich – Tschechische Republik – Deutschland

Zusammenfassung

Ein neuer Typ eines porphyritischen Zweiglimmergranits mit sehr hohem Thoriumgehalt wurde bei der geologischen Kartierung des Böhmerwaldes im Dreiländereck entdeckt (BREITER & PERTOLDOVÁ, 2004). Da die Entdeckung dieses hoch radioaktiven Granits auch vom gesundheitlichen Standpunkt wichtig für die lokale Bevölkerung ist, haben der österreichische und der tschechische Geologische Dienst im Sommer 2005 detaillierte Feldarbeiten und Radioaktivitätsmessungen durchgeführt. Die nachfolgenden petrologischen und geochemischen Studien werden vom tschechisch-österreichischen Programm AKTION-KONTAKT unterstützt (BREITER & KOLLER, 2005).

Abstract

A new type of porphyritic two-mica granite with a very high content of Thorium has been found in the course of geological mapping of the Šumava (Böhmerwald) Mts. in the three corner area (Dreiländereck; BREITER & PERTOLDOVÁ, 2004). While the discovery of this highly radioactive granite is important from the viewpoint of the health of the local population, the Austrian and Czech Geological Surveys organised a detailed geological mapping and field measurement of the radioactivity in this area. The fieldwork was realised during the summer of 2005, the following petrological and geochemical study of this granite is now supported also by the Czech-Austrian program AKTION-KONTAKT (BREITER & KOLLER, 2005).

1. Geological Mapping

In the NW part of the studied area, the coarse-grained, locally slightly porphyritic two-mica Plöckenstein-(Plechý-) granite crops out (Text-Fig. 1). This granite forms an elliptical body (c. 120 km^2) between the Vltava (Moldau) valley to the NE and the Mühl fault zone to the SW. The major part of this body is situated in Bohemia and Bavaria; only a small part of the intrusion crops out in Austria. The SE part of the area is formed namely by biotite gneiss with several small bodies of melasyenite, biotite diorite and Weinsberg granite.

The main body of the studied radioactive granite (preliminarily termed as "Dreiländereck granite") is situated at the SE contact of the large Plöckenstein granite, around the small village of Oberschwarzenberg. From the roughly

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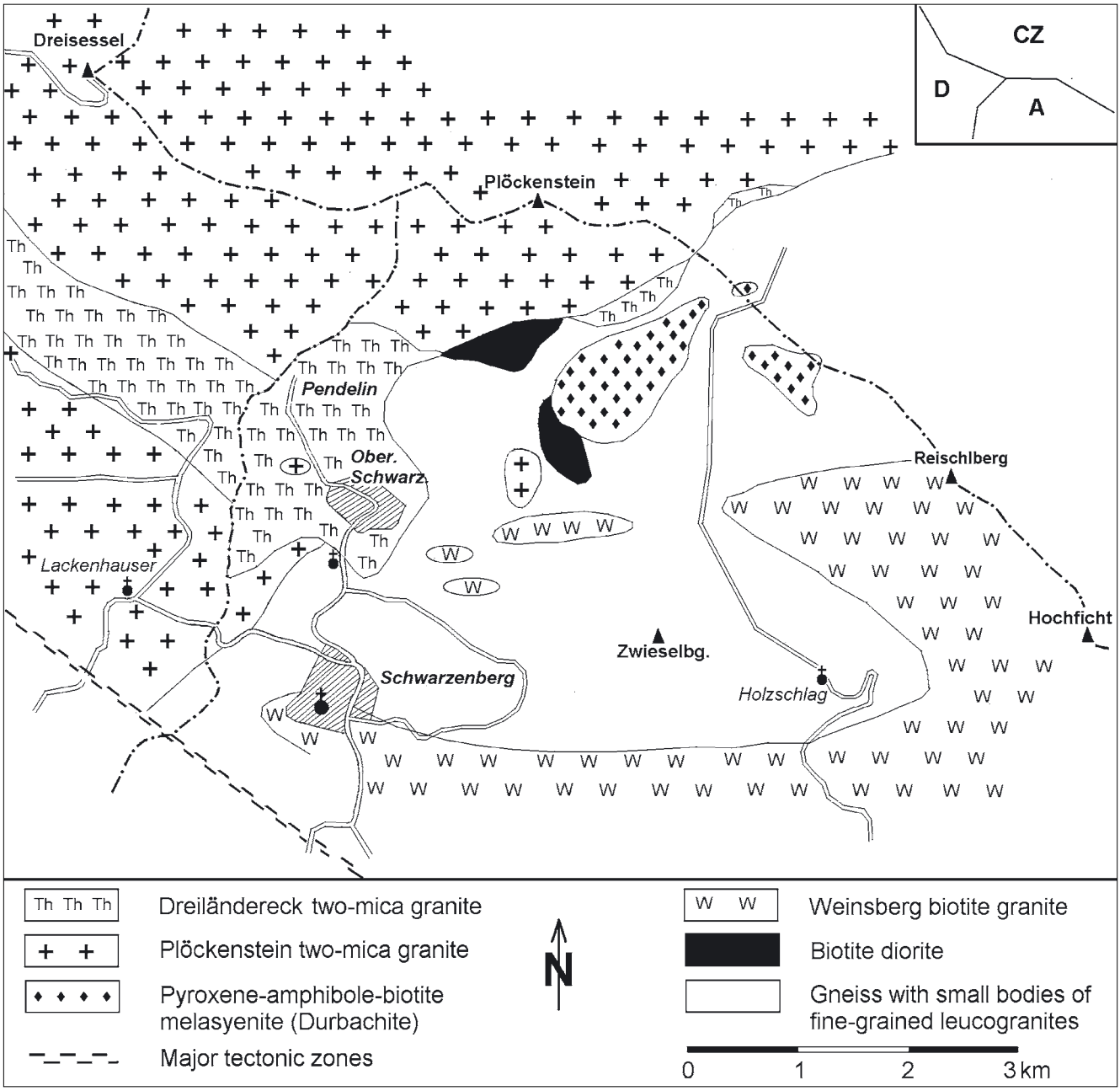


Text-Fig. 1.
Simplified geological map of the studied area.

isometric main body (5 km^2), a bulky apophyse in NW direction crosses the border to Bavaria. Another thin apophyse oriented to NE continues to Bohemia.

The heavy porphyritic medium- to coarse-grained two-mica granite differs from the other two-mica granites in the southern Moldanubicum in a substantially higher content of Kfs-phenocrysts and especially in an extreme content of monazite and zircon inherited in biotite flakes.

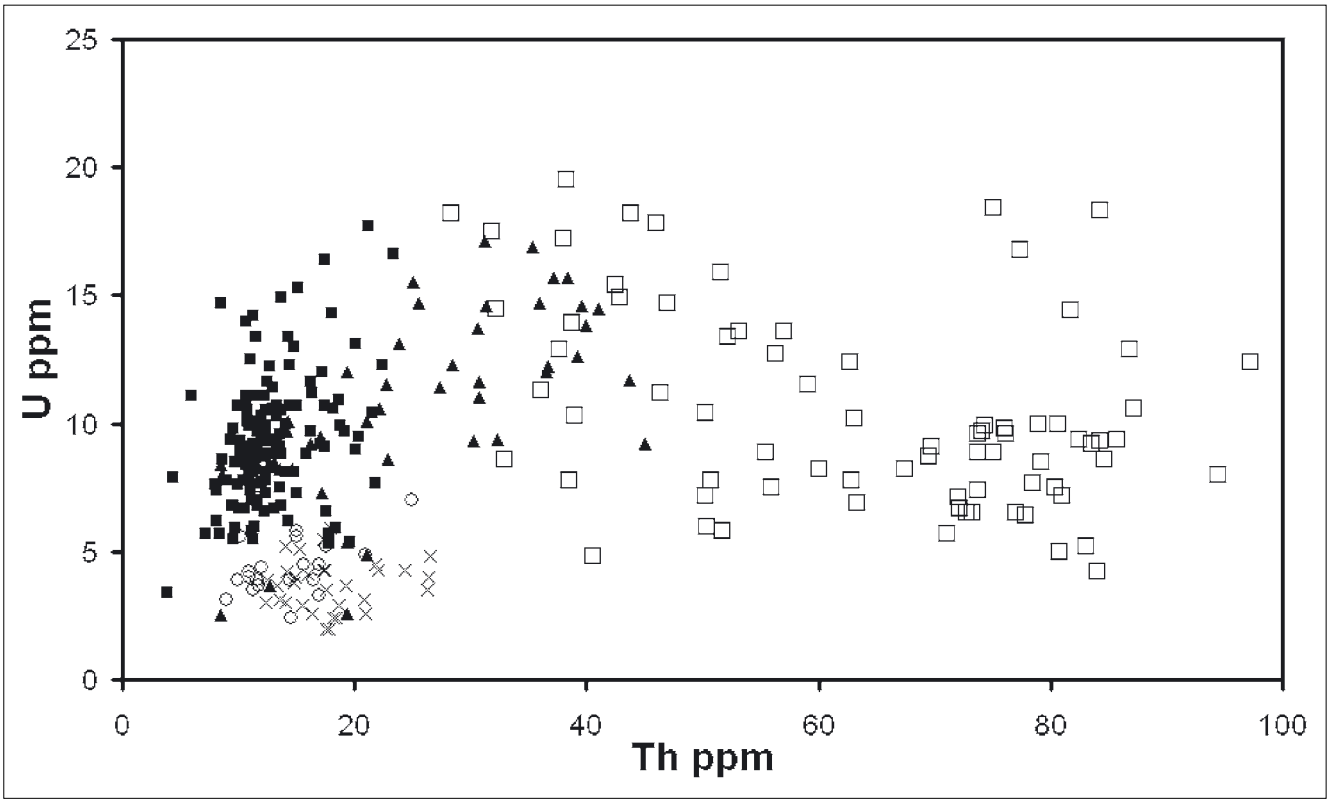
Typical chemical composition ranges: 70.5–71.5 % SiO_2, 1.8–2.2 % FeO_{tot}, 0.4–0.6 % MgO, 0.8–1.0 % CaO, 2.5–2.8 % Na_2O, 4.8–6.2 % K_2O, 170–220 ppm Zr, 50–90 ppm Th. The major host of thorium is monazite containing 12–17 % of brabantite component.

2. Measurement of Radioactivity

Field measurements of radioactivity (spectrometry gamma) and detailed geological mapping has been carried out in an area of about 40 km^2. The results of the field meas-

Table 1.
Contents of uranium and thorium in studied area according to field spectrometry gamma (minimum, average, maximum, in ppm).

Rock type	n	U_{min}	U_{aver}	U_{max}	Th_{min}	Th_{aver}	Th_{max}
Porphyritic two-mica Dreiländereck granite	72	5	10	18	33	65	99
Coarse grained two-mica Plöckenstein granite	140	5	9	17	4	13	23
Weinsberg biotite granite	34	2	4	5	12	18	26
Biotite-amphibole-pyroxene melasyenite	47	5	11	17	11	25	44
Gneiss	21	2	4	7	9	14	25



Text-Fig. 2.
Contents of Uranium and Thorium in rocks (field spectrometry gamma).
□ = Dreiländereck granite; ▲ = melasyenite, ■ = Plökenstein granite: × = Weinsberg granite, ○ = gneiss.

urements of U- and Th-contents on more than 300 points are summarised in Table 1 and Text-Fig. 2. The content of Uranium in all rock types is similar, only occasionally exceeding 15 ppm. In the contrary, the content of thorium is highly variable and may serve as a sensitive indicator of rock type. Gneiss and Plöckenstein granite are the less radioactive rocks in the area, melasyenite is slightly Th-enriched. The Dreiländereck granite is extremely Th-enriched: field measurements give 50–99 ppm Th in outcrops and blocks. The area extent of this granite in now well justified.

3. Discussion and Conclusion

Thorium is a highly compatible element in granitic melts and tends to enter the early-crystallised accessory minerals like monazite and zircon. Thus the Th-content during fractionation rapidly decreases. The two-mica granites from the Moldanubicum (usually termed as Eisgarn-type s.l.) are geochemically relatively evolved rocks enriched in lithophile elements (like Rb, F, U, Sn etc.) and poor in Th (usually 20, occasionally up to 35 ppm; BREITER & KOLLER, 1999). The Dreiländereck granite with 50–99 ppm Th is an exception. Among other magmatic rocks within the whole Moldanubicum, only the variety of Mauthausen-type granite from Gutau near Freistadt is comparable in its Th-content (average 60 ppm, max 124 ppm Th; GÖD [1996]). In both granite types, the major Th-host is monazite and Th-enrichment is not coupled with enrichment of uranium.

The Th-rich granite is geologically younger than the associated much larger body of the Th-poor but chemically similar Plöckenstein granite. The source of Thorium and the processes which lead to its enrichment in the relative late Dreiländereck granite remain unresolved.

The Dreiländerecke granite has been used for the construction of many old houses in the village of Oberschwarzenberg. Due to its high radioactivity, we recommend not to use this rock as a building material in future.

Acknowledgement

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