



U/Pb dating and geochemical characterization of the Brocken and the Ramberg Plutons, Harz Mountains Germany

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Geographical setting

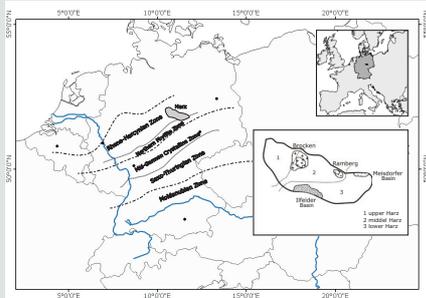


Fig.1: Geographical setting of the Harz Mountains, Germany.

The Harz Mountains (Germany) form a part of the Variscan basement in the southern part of the Rheno-Hercynian Zone of the Central European Variscides. The area is situated close to the suture between Laurussia and Gondwana represented by the Mid-German Crystalline Zone. The Harz Mountains became intruded by a number of granitoids that are believed to be related to the Variscan orogeny culminating in the Devon-Carboniferous time. The two major granitoids in the Harz Mountains are represented by the Brocken and the Ramberg pluton.

Methods

We dated zircons of two samples from the marginal facies of the Brocken and the Ramberg granites in the Harz Mountains using U/Pb single zircon dating by Laser-ICP-MS. Additionally we made geochemical analyses at the ActLabs Ltd., Onatris (Canada) and analysed thin sections of granite samples of both plutons.

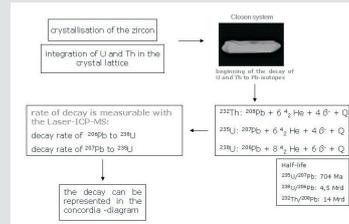


Fig.2: Schematic illustration of the U/Pb-system.

Results

Concordia-Age of zircons from the Brocken and the Ramberg

Figure 3 and 4 show the concordia-diagrams of the dated zircon samples.

The $^{206}\text{Pb}/^{238}\text{U}$ concordia-age of the Brocken pluton could be dated to 283.0 ± 2.1 Ma. The $^{206}\text{Pb}/^{238}\text{U}$ concordia-age of the Ramberg pluton could be dated to 283.0 ± 2.8 Ma and 289.3 ± 0.59 Ma.

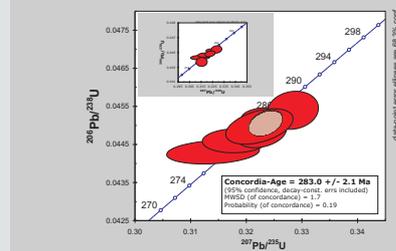


Fig.3: Concordia-diagram of the Brocken pluton sample BG 1 dat.

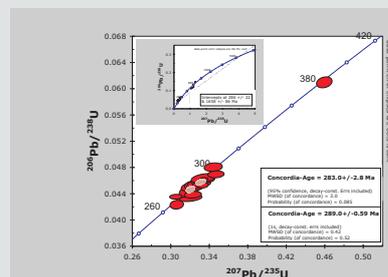


Fig.4: Concordia-diagram of the Ramberg pluton sample RAM 1.

Electron microscopic photographs of zircons from the Brocken and the Ramberg

Electron microscopic photographs (BS and CL) of zircons from the Brocken pluton (BG) and the Ramberg pluton (RAM) (Fig.5 and 6). The photographs illustrate the three different habitus types of both plutons and the dated age. The CL-photographs demonstrate the zonation of the zircons.

Figure 7 documents the typical myrmecitic texture of the Brockengranite samples.

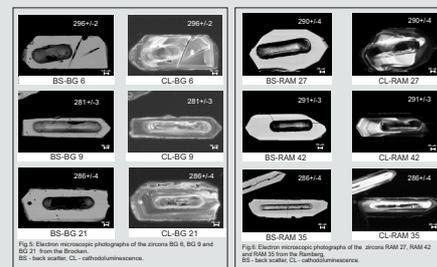


Fig.5: Electron microscopic photographs of the zircons BG 6, BG 21 and BG 21 from the Brocken.

Fig.6: Electron microscopic photographs of the zircons RAM 27, RAM 42 and RAM 35 from the Ramberg.

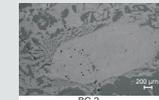


Fig.7: Thin section of sample BG 2.

Geochemistry of the granite samples from the Brocken and the Ramberg

Figure 8, 9 and 10 illustrate the main differences in the geochemical composition of the granite samples from the Brocken and the Ramberg.

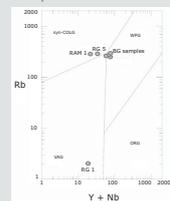


Fig.8: Rb vs. Y+Nb discrimination diagram after Pearce et al. (1989). BG - Brockengranite samples, RAM, RG - Ramberggranite samples

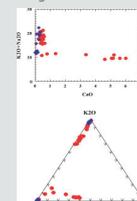


Fig.9: Concentration of the feldspar oxides Na₂O, K₂O and CaO. Brockengranite samples - red, Ramberggranite samples - blue

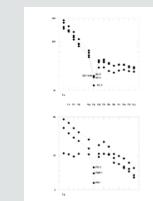


Fig.10: REE-diagram for all samples. BG - Brockengranite samples, RAM, RG - Ramberggranite samples

Conclusion

The measurements of the youngest population of the needle-shaped magmatic zircons show a concordia age of 283 ± 2.1 Ma for the Brocken pluton and a concordia age of 283 ± 2.8 Ma of the Ramberg pluton. Both overlapping results are interpreted to reflect the age of intrusion of these two granitoids. The ages relate the magmatic event documented by the intrusion of the Brocken and Ramberg plutons to the opening of the large molasse basins during the Rotliegend (Lower Permian) and not, as believed for a long time, to the Variscan orogeny. Therefore the geotectonic setting of the two large granitoid intrusions must be re-interpreted. It is characterized by the extension and thinning of the crust during the formation of molasse basins in the central part of the Pangea. Geochemical signatures, shown above, and thin section microscopy of our samples support the assumption of the doming in the asthenosphere and a resulting heat flow responsible to the formation of magmas in the Harz Mountains during the Lower Permian.

Literature

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