U-Pb systematics on zircons from chlorite gneiss of metavolcanic layer V4 (7260-7800m) from the KTB-Hauptbohrung

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Aims

Determination of the extrusion age of meta-volcanic layers (chlorite-gneiss) in the volcano-sedimentary series v4 (7260m - 7800m, Fig. 1), KTB-Hauptbohrung.

Methods

U-Pb analyses on zircons from chlorite-gneiss, supported by cathodoluminescence investigations of internal zircon growth structures.

Results

Fragments of chlorite gneisses (450g) were hand-picked from cutting sampler material (Räumstrecke 7900-7973m).
Zircons from chlorite gneiss are homogeneous, colourless to pink, transparent and prismatic. Inclusions are mainly restricted to the inner part of the grains. Dissolution processes and/or delicate metamorphic overgrowth led to corroded and subrounded, sometimes pitted crystal faces.

Cathodoluminescence investigations (Fig. 2 to 4) display a poly-phase growth history. A xenomorphic inner zone is characterized by an intense variability of luminescence with spotted domains. In most cases, it does not seem to represent an older core, but an early co-magmatic zircon phase. The volumetrically dominant magmatic crystallization phase is characterized by oscillatory zoning and an euhedral outer shape. The final zircon phase forms a small rim around the magmatic core. Occasionally this zircon overgrowth fills up pre-existing tubes and corrosion inlets on the magmatic crystal surface. Such rims were probably grown under metamorphic conditions.

From zircon fraction 7553-2 (Fig. 5 and 6) the outer rim was removed by the air abrasion technique. Thus, the date point is concordant at **488 +/- 3 Ma** (2 σ). Smaller grain size fractions (not abraded) show small amounts of inherited radiogenic lead probably bound to incorporations of older zircon fragments. Therefore, data points shift to higher 207Pb/206Pb-ages. It seems reasonable to relate the lower U/Pb ages of the larger zircons to enhanced Variscan metamorphic zircon overgrowth (the 'over-concordance' of 7553-1 can probably be explained by uranium loss).

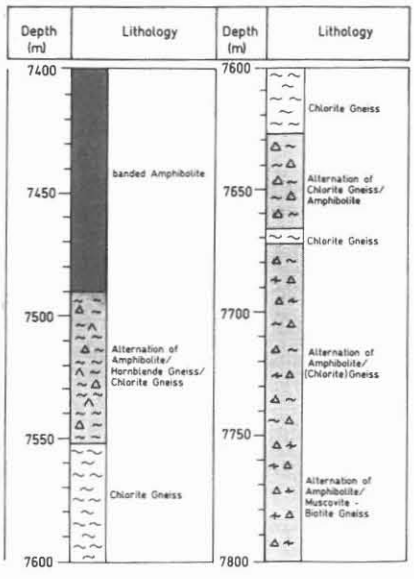


Fig. 1: Lithological profile of the lower part of the volcano-sedimentary series v4. Sampled chlorite gneiss fragments may originate from different layers.

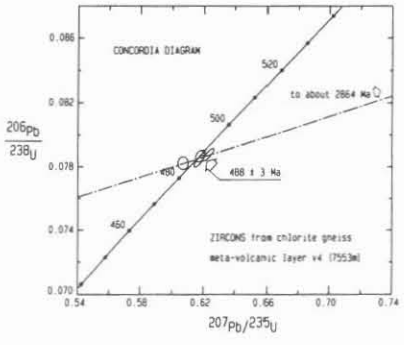


Fig. 5 and 6: Concordia diagram with zircon grain size fraction of chlorite gneiss. Quoted errors are on the 95% confidence interval.

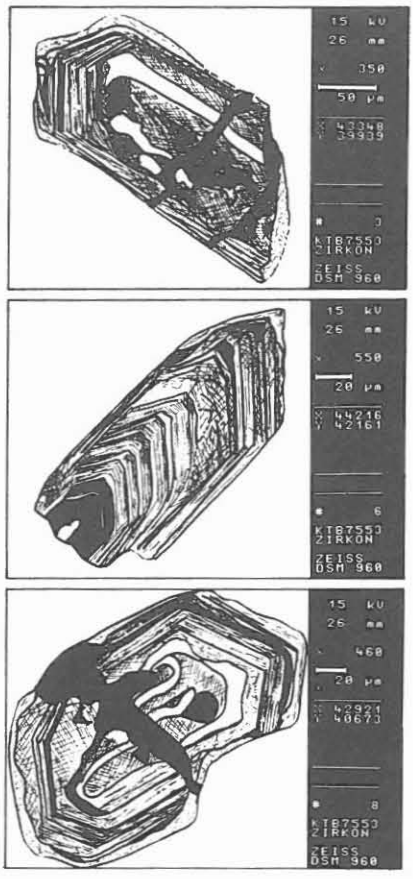
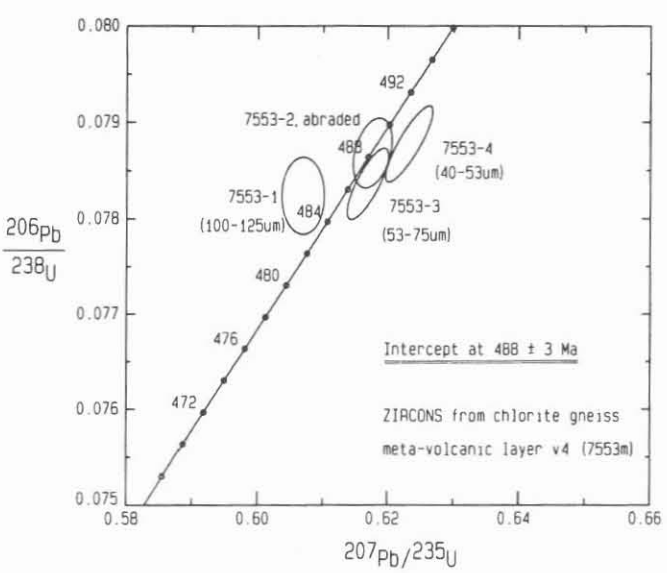


Fig. 2 to 4: Cathodoluminescence photographs of zircons from chlorite gneiss.
An inner zone is separated from a volumetrically dominant magmatic crystallisation phase with oscillatory zoning and an euhydral outer shape. The rim is probably grown under metamorphic conditions.

Conclusions

The age of 488 Ma seem to represent the time of extrusion of zircons from the melt. This protolith age of the volcanic derivation of the series v4 is in good agreement with ages of metabasites from different layers of the KTB bore hole (v. Quadt 1990; Hölzl et al. 1993) and point to an extensional geodynamic scenario (v. Quadt 1993). If the volcano-sedimentary series v4, found directly below the reflector horizon SE1, is compared to that of v1 on top of the recovered core sequence (above 560m) the 488 Ma-protolith age appears to be at variance with that proposed for the sill-ky-grt-bio-gneisses (metamorphic overprint at 509 +12/-13 Ma Miller et al., 1990; Söllner et al. 1993, 1994). The v1 - v4 correlation is strongly supported by petrographic similarities. If we accepte the 488 Ma-age, and ignore possible thrusting, the age of the thermal overprint (metamorphism?) within sedimentary parts of the series v1 (and v4?) probably reflects the age of the source area. Further investigations on these volcano-sedimentary series are needed.



References

Hölzl et al. (1993): KTB-Report, 93-2, 391-392. Miller et al. (1990): KTB-Report, 90-4, 544. v.Quadt (1990): KTB-Report, 90-4, 545. v.Quadt (1993): KTB-Report, 93-2, 393. Söllner et al. (1993): KTB-Report, 93-2, 395-398. Söllner et al. (1994): N. Jb. Miner. Mh. (im Druck).