Dating zircons from volcanic ash beds in sedimentary successions: magmatic crystallization vs. ash deposition

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Detailed calibration of the Late-Middle Triassic time-scale requires precise and accurate age determinations from volcanic ash beds within biostratigraphically well dated marine sedimentary sections. High precision CA-ID-TIMS U-Pb zircon dates on volcanic zircon have been used to quantify and calibrate different stratigraphic schemes across the Early-Middle Triassic boundary in South China. Despite an optimal control on the continuity of the stratigraphic record and on the accuracy of analytical procedures, some single ash-beds from the Monggan Wantuo section (Luolou Fm., NW Guangxi, S. China) yield ages that are too old and contradict the stratigraphic succession. How can we improve the confidence in the interpretation of zircon dates as proxies for the age of deposition of these ash beds?

We dated 15 individual ash beds within the 15m Wantuo Mongan section, applying CA-ID-TIMS techniques on a number of single grains for each sample. In 13 out of 15 ash beds zircon dates are following the stratigraphic succession within analytical uncertainty (from the late Early Triassic Luolou Formation – 248.08 ± 0.12 Ma. to the Middle Anisian Transition Beds – 246.43 ± 0.17 Ma). The zircons from two intermediate volcanic ash beds within the Transition Beds at the Early/Middle Anisian boundary yield well clustering $^{206}Pb/^{238}U$ dates at 247.10 ± 0.15 and 247.35 ± 0.11 Ma, clearly indicating that the zircons in this magma batch were crystallizing over a long period of time or remobilized from deeper levels within the same magmatic system. The problem of recurrent zircon dates in a sedimentary succession is common and can only be discovered by sufficiently dense sampling and a sufficient number of data for each ash bed.

We have to keep in mind that for the correct interpretation of dates in stratigraphic sections interlayered with fossil-bearing rocks we need; i) at least one single well preserved stratigraphic section with sufficient chronological control (biochronology and/or chemiostratigraphy) to guarantee that the stratigraphic succession is accurately known; ii) volcanic ash beds that are undisturbed (no volcanosedimentary material, no sedimentary reworking); (iii) sufficient sample and data density to be able to distinguish between magmatic and sedimentary signals coded in the crystallization ages of zircon.

The Thrym Complex of southeastern Greenland: Evolution of Ni-Cu-sulfide mineralization in the lower crust

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The Thrym Complex of southeastern Greenland forms part of the North Atlantic Craton and is characterized by migmatitic orthogneiss, narrow bands of mafic granulite, ultramafic rocks, paragneiss, and alkaline-carbonatitic intrusive rocks. The narrow bands of mafic granulite are interpreted as tectonically emplaced gabbroic rocks exposed from the lower crust.

The two main styles of mineralization locally observed in the Thrym Complex are: (1) disseminated sulfides associated with mafic and ultramafic locally granoblastic-decussate rocks; and (2) remobilised sulfides concentrated in amphibolite-greenschist facies shear zones. This mineralization observed differs from typical orthomagmatic Ni-Cu-sulfide occurrences common in the upper crust in that there is no evidence for significant contamination by a crustal sulfur source. Furthermore, no trans-lithospheric structure for the emplacement of the mineralization is apparent.

The sulfide mineralization in the Thrym Complex may represent the root of such a system or the result of a similar magma being emplaced in the lower crust in an area lacking such a fluid-pathway. Mantle-sourced magma emplaced at pressure-temperature conditions in the lower crust would maintain or achieve sulfur-saturation more easily than magma emplaced in the upper crust [1]. As such, there may be no need for interaction with crustal material for the formation of sulfide mineralization in lower crustal settings.

[1] Mavrogenes & O'Neill (1999), *Geochimica et Cosmochimica Acta* **63**, 1173-1180.

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