Palaeomag-dating of Kupferschiefer ore at Sangerhausen, Germany – An epigenetic, Late Jurassic age for stratabound Cu-mineralization

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Palaeomagnetic Dating of Mineralization

We have carried out paleomagnetic and rock magnetic measurements on 205 specimens from 15 underground sites from the abandoned Sangerhausen Mining District, Germany. Cu-mineralization is richest in Upper Permian (258±2 Ma) Kupferschiefer black marly shale (9 sites), extending into footwall sandstones (3 sites) and hanging wall carbonates (2 sites). ChRM directions were isolated for all sites using detailed alternating field and thermal step demag-netization. The site mean ChRM directions from the mine stratigraphic section yield a negative fold test that indicates that the ChRM post-dates Triassic to Jurassic fault block tilting of the strata.

Discussion of Results

The mean of all site mean directions gives a Late Jurassic paleopole at 149±3 Ma on the APWP for Europe [1]. This is significantly different (>>99% confidence) from a previous, hematite-alteration- derived paleopole [2] that initially gave an age of 254±6 Ma but cannot be maintained any longer. Our Late Jurassic, i.e. epigenetic, age for the ChRM in the black shale-hosted Kupferschiefer Cu-Pb-Zn ores at Sangerhausen correlates with crustal extension that formed the nearby North German Basin north of the Harz Mountains. This event reactivated major NW-SE striking faults and - arguably - major (ore)fluid pulses, associated with such fault movement. Spatial coincidence of major ore zones with intersections of NW-SE faults and fertile basement rocks additionally support our late, epigenetic metallogenetic model.

[1] Besse & Courtillot (2002) *J Geophys Res* **107**, 1-31. [2] Jowett *et al* (1987) *J Geophys Res* **92**, 581-598.

$\delta^{13}C_{carbonate}$ chemostratigraphy of the Carrapateira Outlier (Lower Kimmeridgian), Southern Portugal

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The Carrapateira Outlier (CO) located 20 km north of Sagres is formed by Upper Triassic to Kimmeridgian sediments. The studied section is located at Três Angras bay and consists of approximately 50 m of limestones interbedded with marls, assigned to the Early Kimmeridgian based on corals, foraminifera and dinoflagellate cysts. The uppermost limestone beds are rich in macrofossils with well-preserved corals in life position. To compile $\delta^{13}C$ chemostratigraphy for this section, sixty five bulk carbonate samples were studied.

The $\delta^{13}C$ values vary gradually throughout the succession showing a baseline with a general decreasing trend up section, ranging from 1,59‰ to -0.68‰. However, the $\delta^{13}C$ curve indicates two main negative $\delta^{13}C$ excursions, the first related to a coarse grained interval with a minimum value of -1.38‰ and a second excursion with a minimum value of -3,10‰, immediately below the bioclastic rich beds of the top of the section. In general, the decreasing baseline trend agrees with the global $\delta^{13}C$ curve for the Kimmeridgian in the Tethyan Realm, where the CO was located. The two negative excursions are tentatively related to regional perturbations in the carbon cycle. Hence, both are interpreted as a result of large input of ^{12}C to the basin as a result from regressive pulses as suggested by the sedimentological and palynofacies analysis studied.