Date them all: Re-Os ages for Upper Jurassic-Lower Cretaceous shales, ammonite zones and chrons

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Numerical ages of Upper Jurassic and Lower Cretaceous stages are derived mostly from correlation of magneto-stratigraphic patterns of Sub-Boreal and Tethyan ammonite zones to the M-sequence marine magnetic anomalies, coupled with constraints from cycle stratigraphy [1]. The ages for Late Jurassic polarity chrons, however, are ultimately based on a model for gradually increasing Pacific spreading rates from ~170 Ma to ~125 Ma that has only a few age constraints [1]. This sequence of correlations with little radiometric age control is further complicated by the extreme faunal provincialism during the late Jurassic.

Here we present Re-Os ages for organic-rich shale from the Upper Jurassic-Lower Cretaceous Hekkingen Formation in the Norwegian Arctic. Three intervals with detailed Boreal biostratigraphy yield isochrons with precision better than 1%, including the ^{187}Re decay constant uncertainty. In the Nordkapp Basin, the base of the section in the *A. serratum* Zone (correlated with the Tethyan *P. bifurcatus* Zone, chron M29r) yields a late Oxfordian age of 157.8 Ma. In the Troms III locality to the SW, an interval in the *A. Subkitchini* Zone (correlated with the Tethyan *S. Platynota* Zone, chron M25) yields a Kimmeridgian age of 154.7 Ma. The top of the section at Troms III is no older than the Sub-Boreal *H. kochi* Zone (correlated with the Tethyan *S. boissieri* Zone, chron M16). Combined with the top of the Nordkapp Basin section, these samples yield a Valanginian age of 137.8 Ma. In addition, shales from the *A. eudoxus* or *A. autissiodorensis* Zones (Tethyan *H. beckeri* or *H. hybonotum* Zones, chron M23 or M22A) yield a less precise Tithonian (?) age of 150.3 Ma. Published Late Jurassic Re-Os ages [4,5] are critically evaluated and integrated with our new ages to refine the time scale for Upper Jurassic-Lower Cretaceous stages.

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[1] Gradstein *et al* (2012) *GTS 2012*; [2] Wierzbowski and Smelror (1993) *Acta Geol. Pol.* **43**, 229-249; [3] Smelror *et al* (2001) *NPF Spec. Publ.* **10**, 211-232; [4] Selby (2007) *Norw. J Geol.* **87**: 291-299; [5] Cohen *et al* (1999) *EPSL* **167**, 159-173.

Micromorphology investigations by imaging alteration, supergene and anthropogenic processes in regoliths

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Micromorphological investigations on undisturbed samples by microscopic and ultramicroscopic techniques allow us to interpret the processes behind the formation of regoliths, sediments and anthropogenic deposits. Keywords are fabric, groundmass composition, microstructures and pedo/biofeatures.

The composition of the micromass represents a record of the processes of alteration leading to regolith formation. The groundmass consists of fine (micromass) to coarse constituents organised with a specific spatial distribution and varying types of preservation history. Investigating the groundmass thus provides clues on the paleoenvironnemental conditions, the different genetic processes behind rock and soil formation (supergene, low T hydrothermal, anthropogenic) and their impact on ecosystems or paleoenvironment.

Improvements in electron microscope imaging technology now permits us to make detailed micromorphological observations up to the nanoscale (previously limited to microscale) : another domain of observations is open in the micromass to the micromorphologists. Optimisation of the microgeochemical mapping technique is another powerful tool to gain insight in chemical migration fronts. Limits concerning homogenisation of the fabric and disapearence of rock fabric may be bypassed. However, if this new detailed information is not linked to petrographic macroscopic evidence and field observations, the analyses may remain ambiguous.

Different petrographic and electronic images of the mineral paragenesis in the micromass associated to their microgeochemical characteristics will be discussed. Examples will be given of the climatic record of different paleosoils, the impact of previous hydrothermal alteration on saprolites, the evolution of the weathering process, and neo-formation of minerals related to weathering and protosoil formation in mining waste rock piles.

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