

Re-Os chronology of the Mjølner meteorite crater, Barents Sea: Impact age and seawater recovery

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The timing of a meteorite impact is determined by the age of sedimentary rocks directly overlying impact breccias, or by the age of distal sedimentary sections disturbed by impact ejecta, tsunamis, or other environmental effects. Here we offer the first radiometric age for the impact of the ~1.5-km-wide Mjølner meteorite, which penetrated ~400 m of water to create a 30-km-wide crater on the sea floor. The Re-Os age of 141.9 ± 2.7 Ma (MSWD = 4.6) was acquired from 14 shale samples from 2.8 m of drill core, starting ~1 cm above the top of the debris horizon. The age agrees perfectly with the biostratigraphic age of 142.2 ± 2.6 Ma, based on the post-impact algal bloom of *Leiosphaeridia* [1].

The isochronous result derived from the first organic-rich mud deposited on the impact breccias also records the rapid return to a normal marine environment. The initial $^{187}\text{Os}/^{188}\text{Os}$ ratio of 0.595 ± 0.033 is in line with the well-documented gradual increase in seawater $^{187}\text{Os}/^{188}\text{Os}$ through the late Jurassic [2]. A second drill core 500 km southwest of the impact crater, shows sharp increases in Ni and Cr concentrations, Th/U ratio, and abundance of *Leiosphaeridia* [3]. Although there is no disturbance of the parallel laminated shale at this level, the biological and chemical peaks are assumed to represent the sindre bed, influenced by fallout from the impact. Remarkably, there is no significant deviation in the Re/Os or $^{187}\text{Os}/^{188}\text{Os}$ ratios across this interval. Re and Os concentrations, however, dip to low values.

Together, these data suggest that fine debris from the impact was transported at least 500 km to the SW. Carried along were elements low in typical mudstones, but high in meteorites – Ni and Cr. Rhenium, Os, and U are characteristically high in organic-rich mudrocks, but may have been diluted by the increased detrital material at this interval. Overall, at 500 km distance, effects of the impact are limited to modest biological and chemical anomalies over a few dm of mudstone.

References :

- [1] Smelror, M. & Dypvik, H. (2005) NGU Bull. 443: 61-69.
- [2] Georgiev, S.V. et al. (2017) EPSL 461: 151-162.
- [3] Dypvik et al. (2006) P-cubed 241: 621-636.