EBSD analysis of belemnite rostra: A screening tool for diagenetic alteration

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Belemnites (Belemnitida) were a common group of stem-decabrachian coleoids of the latest Triassic – Cretaceous [1]. Stable isotope ($\delta^{13}C$, $\delta^{18}O$) and element ratios of belemnite rostrum calcite have frequently been used to reconstruct environmental conditions of the Jurassic and Cretaceous periods. The largely unknown habitats of belemnites [2] [3], metabolism induced vital effects and diagenetic overprint affect geochemical signatures derived from belemnite calcite. The validity of the usually applied diagenesis screening methods (trace elements, cathodoluminescence microscopy (CL)) has, however, been doubted (e.g. [4]).

To overcome the difficulties of these screening methods, we applied electron backscatter diffraction (EBSD) to belemnite rostra in addition to CL and trace element concentrations. We visualize and record different grades of recrystallization with EBSD maps and an assessment of the degree of calcite crystal co-orientation. EBSD data of belemnite rostra of different preservation states are compared with CL and geochemical proxies ($\delta^{13}C$, $\delta^{18}O$, element ratios) in order to test the applicability of these methods for an indication of recrystallization.

We show interspecies as well as intraspecimen differences in the state of preservation, resulting from varying responses of belemnite microstructures to diagenesis. Organic matter is shown to be an important factor for the preservation of belemnites. The comparison of EBSD and CL data shows that the CL-patterns of belemnites are in part of primary and in part of secondary, diagenetic, origin.

These new findings demonstrate, that EBSD is a feasible tool for screening diagenesis induced recrystallization of belemnite rostra. Our results also confirm CL-microscopy as a screening method by identifying typical CL-patterns of well-preserved belemnites. The implications of these results for geochemical studies of belemnite rostra are discussed.

[1] Fuchs *et al*. (2013) *Palaeontology* **56**, 1081-1106 [2] Mutterlose *et al*. (2010) *EPSL* **298**, 286-298 [3] Stevens *et al*. (2014) *Lethaia* **47**, 512-523 [4] Li *et al*. (2013) *Palaeo3* **388**, 98-108