Geophysical Research Abstracts, Vol. 9, 04524, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-04524

Mesozoic belemnites re-visited: the limitations of a single approach

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Belemnite guards are currently being used in two fields of geosciences: a) taxonomy, evolution and biostratigraphy are aspects considered by palaeontologists, b) stable isotope studies are performed by geochemists. Only few studies cover aspects of both fields. For more than 50 years the calcareous guards of belemnites have been used to gain ?18O- and ?13C data of the Cretaceous. Fluctuations of the ?18O data indicate variations of the ice volume and palaeotemperature, those of the ?13C value are explained by changes in the biopoproductivity of the oceans. The observed data have been used to postulate seasonal or secular temperature or productivity variations of the sea water. All of these studies have serious setbacks, in so far as they neglect biological aspects. One of the problems is that taxonomically heterogeneous groups have been used. Data derived from different species or even genera have been lumped together, ignoring possible species dependant fractionation of the stable isotope signature. A second drawback is the neglection of ontogenetic and ecological aspects of belemnites. In order to approach this problem we have concentrated on the stable isotope signature of three different groups of coleoids: Recent Sepia, mid Jurassic Megateuthis and early Cretaceous belemnites. These data are discussed for all three groups with the following results. Recent Sepia: The ?18O signature is clearly controlled by temperature, with early ontogenetic stages preferring shallow warm waters and later stages living in cooler, deeper water. Specimens from different latitudes clearly reflect these temperatures. The ?13C signature is rather controlled by biofractionation. Jurassic Megateuthis: The trace elements and stable isotopes investigations of mid Jurassic megateuthids indicate no significant variation of the ?18O-values during ontogeny. This indicates no changes in the habitat throughout life and rather suggests life in a stable setting, without changes of water masses Cretaceous belemnites: Observations

of Cretaceous belemnites show, that a biofractionation of the stable isotopes and trace elements occurs on a generic level. Various belemnite genera from the Valanginian - Barremian show different ?18O- and ?13C-signatures. The ?18O-values for populations (>100 specimen of one species collected from one horizon) vary by 2.0L' (˜ 8°C) These observations suggest that the isotopy of single belemnites is unsuitable for recording reliable T°C. The isotopy of belemnite populations varies, however, through time, recording T°C changes. The isotopy may reflect a salinity signal of surface waters. TEX86 data and ?18O-values gained from the same horizon indicate a significant shift of the belemnite data towards cooler temperatures by 4°C. This implies either that belemnites were deep dwellers or increased salinities of the surface waters.