Paleoceanographic variations in NW Tethys through the Early Jurassic inferred from Neodymium isotopes recorded in fish teeth

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Introduction:

The Early Jurassic was a period characterized by a succession of important paleogeographic, paleoenvironmental and paleoclimatic events. Constant increases of the sea level combined to rifting phases initiated the development of marine corridors, leading to connexions between Tethyan and Boreal oceans via the Viking Corridor, and between Tethyan and Pacific oceans via the Hispanic Corridor. Recent studies based on $\delta^{18}O$ and Mg/Ca of belemnites and brachiopods have also highlighted significant variations of seawater temperatures during the Early Jurassic (McArthur et al., 2000; Bailey et al., 2003; Rosales et al., 2004; Van de Schootbrugge et al., 2005a; Metodiev and Koleva-Rekalova, 2006; Gómez et al., 2008; Suan et al., 2008). Available data suggest slight warming during the Carixian, followed by significant cooling during the Domerian, while intense warming events occurred during the Early and Middle Toarcian. However, seawater temperatures derived from belemnite and brachiopod $\delta^{18}O$ values remain controversial owing to large freshwater inputs, chiefly during the Toarcian, that make it difficult to decipher the respective influences of temperature and $\delta^{18}O_{seawater}$ variations in the calcite $\delta^{18}O$ signal (Bailey et al., 2003; Suan et al., 2008). Moreover, the origin of these variations is still debated (volcanism, clathrates, paleoceanographic perturbation). Thus, combined approaches integrating independent paleoclimatic and paleoenvironmental proxies remain essential to improve our knowledge of this major disturbed climatic period.

Purpose:

The goal of this work was to detect eventual paleoceanographic perturbations linked to the opening of corridors in the NW Tethys, and to establish possible relationships with temperature variations. Our method consists to study the Neodymium isotopes of Early Jurassic fish teeth recovered from Hettangian to Late Toarcian sections from Belgium, Luxemburg, and NE France. The neodymium composition (ε_{Nd}) is a proxy reflecting changes

in erosional inputs and oceanic circulations (Pucéat *et al.* 2005). Indeed, the Nd isotope composition of seawater is not uniform between different basins because of the relative radiogenic contribution from ancient continental versus young volcanogenic material. Thus, seawater situated near old Fennoscandian massifs generally receive unradiogenic inputs whereas waters circulating through the Hispanic Corridor should be very radiogenic owing to CAMP (Central Atlantic Magmatic Provence) situated in its center. Thus, if corridors were opened, significant ε_{Nd} variations should be observed Tethyan seawaters.

Results and preliminary discussion

Our preliminary results show important variations of neodymium isotope values through the Early Jurassic. Values are generally very unradiogenic (between -8 and -10) and could reflect a constant influence of arctic waters coming from the Viking Corridor. Maxima occur during the Early and Late Toarcian and are interpreted as a possible deepening of the seaway, allowing an important circulation of freshwater which disturb the oxygen isotope signal (and overestimate temperatures). During the middle Pliensbachian, values are poorly unradiogenic, and are interpreted as the signal of currents coming from Tethys or Hispanic Corridor.

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