COMPOSITION AND ORIGIN OF HYPERSALINE EASTERN MEDITERANEAN BRINES WITH EMPHASIS TO URANIA BASIN

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Abstract
During the last two decades an increasing number of anoxic hypersaline lakes has been discovered in the eastern Mediterranean and characterized in successful EU projects such as PALAEOFLUX, MEDRIFF, SAP, and BIODEEP, and the French-Dutch MEDINAUT programme. Brine basins are extreme environments with one of the highest dissolved sulphide concentrations ever reported for the 'open marine' environment (up to more than 12 mM), and demonstrating large compositional differences between different brine pools: going from a nearly 5 M MgCl2 solution and below seawater Na content (Discovery Basin) to a nearly saturated 5.3 M NaCl solution(Tyro Basin). The recently discovered Nadir brine is high in NaCl, methane, and possibly sulphide, and seems rather 'recent'. The Medee Basin, recently reported, is also NaCl-rich.
Keywords: Eastern Mediterranean, Deep Sea Processes, Deep Sea Basins

One of the most extreme environments thus far discovered is Urania Basin which contains the highest radiogenic supersaturations ever observed for the marine environment (3He / 4He of 1.10-7 and 40Ar / 36Ar of 470) [1], the most extreme d11B (28‰) [2], the highest methane content (> 260 µl/ml), and the highest bottom water temperature (> 48oC). Irregular methane-driven mud-eruptions appear to occur from the latter bottom at least up to 600 m above the basin-floor, i.e. to a water depth of 2900 m. The composition of most of the brines seems to relate to a 'relict brine' or the dissolution of evaporites both originating from the Messinian period during which the Mediterranean is thought to have been desiccated (Bannock, Atalante and Tyro Basins). On the basis of various isotopes for most of these basins the 'relic brine' option seems the most plausible. In addition, the compositions of relevant major and minor elements appear to be in near coincidence with the theoretical seawater evaporation path. Urania brine is the most extreme exception to this picture, its major and minor element composition, but in particular its isotopic signature clearly relates to a source area that must be much deeper than that of the Messinian evaporites, and which is clearly influenced by high-temperature interactions with old sediment and volcanic units. In addition to their individual compositional characteristics, each brine demonstrates a typical and for most of them rather stable internal brine structure of various different brine levels. Subtle as well as outspoken temperature and compositional differences occur between the different brine levels in individual basins. The transition between different brine levels, and between brine and seawater may be relatively gradual but usually is extremely abrupt. In particular the seawater/brine transition is dramatic changing from seawater to 10x seawater concentration within a depth interval of 100 cm. The interface is further characterized by a strong dip in Transmission (= high suspended matter content, but possibly partly related to reflection of waters of different densities) [3, 4].

References

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