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Origin and permeability of deep ocean salts

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Large, buried salt bodies occur in numerous offshore rift-related sedimentary basins, worldwide. For most practical purposes, the conventional evaporite (solar evaporation of seawater) theory is adequate for explaining these occurrences. However, a new model for their formation has now been published (Hovland et al., 2006; 2007, 2008). This model relies on the properties of supercritical water, a fluid which does not dissolve salt (within specific temperature and pressure ranges).

The model predicts that some of the large volumes of salt occurring underground in the Red Sea and also in the Mediterranean Sea, formed by forced hydrothermal circulation of seawater down to depths where it became superctical (i.e., temperatures above 405ºC, and pressures above 300 bars). Thus, salt precipitated under-ground and filled up cracks and crevices and also formed massive accumulations, which partly flowed upwards as dense, hot brines, precipitating more solid salts upon cooling.

In addition, Holness and Lewis (1997) have shown experimentally that salt bodies subjected to high pressures and elevated temperatures, acquire a permeability comparable to sand. This is because the crystalline structure of salt (halite) attains dihedral angles between salt crystals less than 60º at higher temperatures and pressures, allowing water to form continuous strings around all salt crystals. This allows hot dense brines to migrate through the salt. Thus, the salt may act as conduits for flow of brines and salt slurries from previously accumulated salt in the subsurface. If these brines reach the sea floor, they can also form brine-pools and layered salt bodies on the sea floor.

An IODP Pre-proposal (No. 741-pre) is now actively promoting drilling some targets in order of checking out this new theory against the conventional evaporite model. It is hoped that European scientists will take up this question and actively promote drilling into salt bodies, for example in the Red Sea (The ‘Atlantis II’ and ‘Conrad’ Deeps) and into buried salt structures in the Mediterranean Sea.

References

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