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Isostasy-controlled thinning-upward cycles in the Mediterranean?; a comparison with the Zechstein salt giant

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The desiccated deep-basin model, originally developed for the Mediterranean salt giant, deviated significantly from existing models and it has never been satisfactorily translated into a general concept. With time, however, Mediterranean models evolved towards moderate basin depths and the view that deposition took place in a flooded basin has gained reputation. These new insights have bridged the gap with general evaporite models and open possibilities of integrating concepts developed for other salt giants into the model.

Recent modelling work (Van den Belt & De Boer, 2012) based on the Zechstein salt basin has shown that the thickness and composition of subsequent evaporite cycles can be explained by a model that involves a repetition of a three-stage process of 1) progressive narrowing of an ocean corridor in response to sulphate-platform progradation, resulting in 2) brine concentration and rapid infilling of the basin with halite and potash salts, the load of which causes 3) isostatic creation of accommodation space for the next cycle.

Isostatic theory predicts that each cycle has approximately half the thickness of the previous one, e.g. $1.0 > 0.50 > 0.25 > 0.125$ followed by a number of (coalesced) smaller cycles with a joint thickness of 0.125. The sequence in the basin centre then adds up to 2, which is two times the original basin depth. For the Zechstein case actual cycle thickness well matches these predicted values with cycle thicknesses of about $1.06 > 0.54 > 0.18 > 0.10$ and 0.12.

The cycle build-up of the Mediterranean salt giant is less well known, because of limited deep drilling. There are at least two cycles, a thin upper overlying a thick lower unit, but comparison of Zechstein patterns with Mediterranean sections has shown that more cycles may be present. Typical cycle boundaries include K/Mg-salt interbeds in halite units, and halite interbeds in sulphate units. Interestingly, analysis has shown that such indicators in Mediterranean sections indicate that cycles may indeed be stacked according to the 50% thickness rule. Examples are the K-salt halfway up the Sicilian section and the regular halite interbeds in the Upper Evaporite of the Western Mediterranean. In addition, the Lago Mare clays that define the top of the Mediterranean section are reminiscent of the Zechstein claystone cap. If the proposed mechanism indeed applies to the Mediterranean it would point at an initial basin depth of about 600-700 for the Western Mediterranean.

Van den Belt & De Boer (2012) Utrecht Studies in Earth Sciences, v. 21, p. 59-65.