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Meganodular anhydritization in the Tertiary Ebro basin (Spain)

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A number of gypsiferous units in the Tertiary Ebro Basin (Spain) are located along their southern margins. These units, aged Paleogene to Miocene, were accumulated in small shallow saline lakes of low ionic concentration, in which Ca-sulphates (gypsum/anhydrite) precipitated. The lakes were nourished by groundwater from deep regional aquifers, which had the recharge areas in the bounding chains and recycled sulphates/chlorides from the Mesozoic (Triassic, Liassic) evaporites. Some of these units graded laterally to the thick, highly-saline (halite, glauberite, polyhalite) evaporite units developed coevally in the basin centre.

In the gypsiferous marginal units, meganodules and large irregular masses (from 0.5 m to >5 m in diameter/length) of secondary gypsum are present in outcrop. These particular features originated as anhydrite, which displaced/replaced the host-gypsum rocks. Although these features mainly display stratiform arrangements, also vertical disposals are found locally suggesting the circulation of ascending flows. The isotopic values (δ^{34}S and δ^{18}O; ^{87}Sr/^{86}Sr) of these features are the same than those of the gypsum host-rocks, suggesting that the precursor anhydrite derived from the in situ replacement of the depositional sulphates. Commonly, the host-rock of the meganodules has been preserved as primary gypsum in the Miocene units.

The common characteristics of the meganodules/irregular masses suggest that the anhydrite growth happened in burial conditions from shallow to moderate depths. The anhydritization was caused mainly by the same hydraulic systems feeding the marginal saline lakes. With progressive burial of the gypsiferous units, the gypsum-to-anhydrite conversion initiated in few nucleation points and progressed slowly and to variable depths. At such depths (from some metres to few hundred metres?), the regional ascending flows probably had temperatures (>25ºC) and solute contents higher than today. Additionally, compaction brines expelled from the thick, highly-saline central units could have mixed with the regional flows increasing their salinity. As a result of this, these flows became anydritizing solutions and affected irregularly the subsiding gypsiferous units before they reached deep burial conditions.

The characteristics of this meganodular anhydritization are completely different than those of the anhydrite formed in sabkha setting or in deep burial conditions. It is thought that this anhydritzation mode could also have developed in the margins of other evaporitic basins in which chemical recycling of ancient evaporites occurred.