b45 Mediterranean evaporites < Messinian salinity crisis >

'The Mediterranean.' The Romans had called that body of water—the, whole chain of inland seas between Africa, Asia, and Europe—*mare internum* or *mare nostrum*. Solinus was one of the first to call these the 'mediterranean' seas—seas in the middle of the earth. The celebrated Isidore of Seville [ca. 560-636] converted 'mediterranean' into a proper name, and the authority of Isidore was not to be gainsaid! —Daniel J. Boorstin, *The Discoverers*.[4]

William Maurice "Doc" Ewing (1906-1974) not content with merely echo sounding deepsea floors intuited that a lit dynamite stick thrown overboard and timed to explode underwater would provide a big enough noise to return echoes from the base of deep-seafloor sediments.[5] The method was first used off the American research vessel *Chain* operating during the 1950s out of the Woods Hole Oceanographic Institution in the Mediterranean. A surprise finding was that a strong reflector—prosaically named the M layer, for Mediterranean, by *Chain*'s senior scientist John Brackett Hersey (1913-1992)—occurs there *within* the deep-seafloor sediments.[6] Samples of this obtained by seafloor drilling in 1973 are evaporites. That evidenced the startling image of an episodically dry Mediterranean basin (***Figure b45.1***).[7]

Messinian salinity crisis Ten times more water evaporates from the surface of the Mediterranean than is returned by rain and river inflow. The balance is supplied by inflow of seawater through the Strait of Gibraltar.[8] Without this, the Mediterranean would loose by evaporation its total volume in 1000 years. M-layer evaporites are many times the volume of salt in the seawater that fills the Mediterranean basin at any time. So the M-layer evaporites record long durations when Atlantic seawater inflow was a trickle that evaporated completely away from where it pooled on the Mediterranean basin floor (***Footnote b45.1***). The M layer evaporites stopped accumulating 5.33 million years ago and had begun to accumulate some six hundred and thirty thousand years before.[9] This is the time of the Messinian salinity crisis.[10] ❑

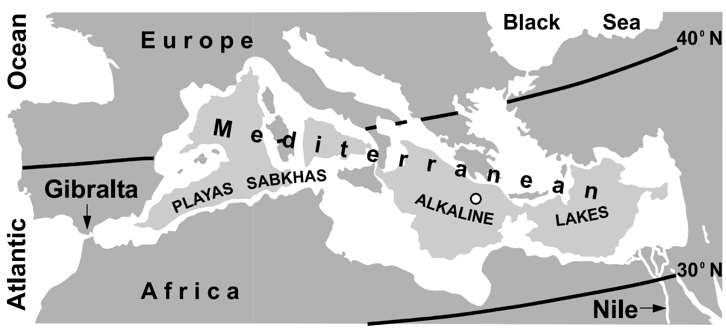

Figure b45.1 Playas, sabkhas and salars existed where today the floor of the Mediterranean is more than 3000 meters (shaded) deep. Further evidence that the Mediterranean dried up, reported by Klaus Wallmann in 1997, is a large extremely salty underwater lake of concentrated magnesium chloride brine sitting above a thick deposit of salt in a three-kilometer-deep depression called the *Discovery Basin* (indicated by the small white circle). The brine can only have been produced when an evaporite called *bischofite* is redissolved in water.[11] Stefano M. Bernasconi explains:[12] "Precipitation of halite results in a decrease in the Na/Cl ratio of the residual brine because halite removes Na and Cl in a molar ratio of 1:1, compared with a Na/Cl ratio of 0.86 in seawater. ... Consequently, a brine that has precipitated halite will have a lower Na/Cl ratio than seawater ... In contrast, if the brine is formed by dissolution of halite, it will have a Na/Cl ratio closer to 1. In general, brines with Na/Cl ratios >0.86 and a predominance of Na over Ca, Mg, and K are good indications that halite is the main source of chloride. Very high concentrations of dissolved Ca, Mg, and K relative to Na suggest that the brine is derived from dissolution of late-stage [bittern salt] evaporite minerals" as: (in order of increasing solubility) carnallite ($KMgCl.36H_2O$), tachyhydrite ($CaMg_2Cl_6.12H_2O$), and bischofite ($MgCl_2.6H_2O$) (Manheim, 1974).[13] Bischofite is the very last salt that is formed when more than 99 percent of seawater has evaporated.