A model of evaporite genesis

by

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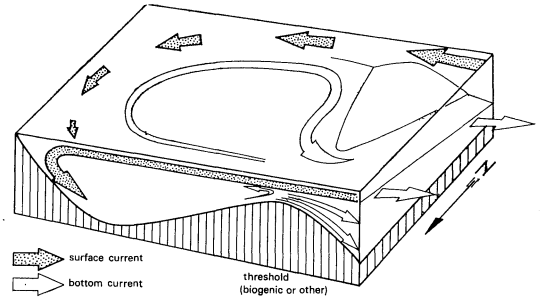
A marginal sea or bay in an arid or semi-arid region is a potential evaporite basin. Its water level does not differ from that of the open sea. Within the marginal sea a water loss is recorded and this may be computed as area of water surface multiplied by rate of evaporation per unit of time. This water loss is compensated by runoff, rainfall and inflow. The velocity of inflow is controlled by the climatic water deficit of the basin and the geologic configuration (cross-sectional area) of the basin entrance. Evaporation progressively concentrates surface currents and these descend in time to provide a dense bottom counter-current and outflow. As the velocity of inflow increases, frictional drag on the bottom current causes more and more of these waters to recirculate into the basin.



Salt concentration in the basin will commence, once the total salt content in the normal or low-salinity surface current entering the basin exceeds the discharge of salts in the high-salinity bottom current in the same time interval. This imbalance in the salt budget of the two currents eventually leads to saturation for salts of lowest solubility and hypsum precipitates. Further concentration leads to halite or even potash precipitation, even though the bottom current can still flush out the salts of yet higher solubility. Wetter or cooler periods lead to reduction of water loss by evaporation and to sligth reduction of salinity. The waters revert to precipitating salts of lower solubility, which enter with the inflow. Thus we find halite intercalations in potash deposits or gypsum and dolomite breaks in halite sequences. They can be used for stratigraphic correlation, for they reflect short-term, climatic cycles over the whole region. The greater the initial depth of the basin, the greater the water volume that must reach saturation and the longer the required duration of arid, climatic conditions prior to evaporite genesis. A filled basin, a basin with insufficient subsidence during precipitation, dries out from the margins. Mud cracks and other indicators of sub-aerial desiccation are characteristic features of the terminal phase.

Since the inflow-outflow interface is tilted to the south, subsidiary basins along southern shores are more easily flushed out. Embayments with evaporite deposition are thus more often found along northern shores. A number of electrostatic, pressure and thermogravitational effects counteract normal diffusion and preserve the density stratification induced by a heliothermal temperature. This layering prevents convection and oxygenation. Depressions in the bottom topography accumulate stagnant, denser waters with black, putrid muds, rich in organic matter. This material is derived from entrapped sinking plankton, bacterially stripped of its oxygen, nitrogen and sulphur content.

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