THE DRYING UP OF THE MEDITERRANEAN

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The long history of the Earth - some 4500 million years, has been elucidated by looking at rocks, at what they are made of and what they contain. This investigation began with speculation, then by looking followed by further speculation, then by detailed examination of rocks in the field and finally by applying a wide variety of experimental techniques in the laboratory. Still today, however, one has first to explore and discover the specimens before they can be subject to this vast array of tests. A major step forward has been the ability to study the behaviour of materials under conditions of high temperature and pressure which obtain at deep levels within the Earth.

We have become accustomed to seeing, on television, models of continents moving rapidly (geologically speaking) over the surface of the globe and ramming into each other to form mountain ranges, to asteroids impacting on the Earth bringing widespread death and destruction, to global changes of climate and of sea-level, to long-continued and catastrophic volcanic eruptions, and so on - the list is very long.

One relatively minor but intriguing story is that of the drying-up of the Mediterranean and more recently of its overflowing into the Black Sea and the surrounding lowlands. But first a bit of geography, so please refer to an atlas. Several million years ago, the Mediterranean was part of a broad seaway linking the Pacific and Atlantic oceans. The coming together of Europe and Africa eventually severed this connection though maintaining a link with the Atlantic through the Straits of Gibraltar. This link enabled world-wide oceanic waters to enter the Mediterranean and maintain its saltiness. At its eastern end the sea has connections with the Black Sea through the Bosphorus. A number of rivers, particularly the Nile, Rhône and the Danube, bring in fresh water but in small volume compared with the volume of the sea which in some places reaches a depth of 3000 metres.

From about 1830 onwards there had been suggestions, based on the nature of fossils, that the environment of the Mediterranean had changed markedly at a date now known to be between 6-5 million years ago. In the 1890s a borehole at Valence in the Rhône valley, 200km from the river mouth, proved a gorge 100s of metres below sea-level cut into hard granite and filled with marine sediments overlain by river sands and gravels. A river can only cut down its bed to sea- level so this suggested that the level had at one time been much lower. Then in the 1930s oil-company geologists working in Libya reported buried channels 400m below sea level and running towards the coast. They proposed a sea level several hundred metres below the present but the ‘establishment’ refused to publish their results - a not-unusual case if the suggestions do not conform to orthodox thinking! Investigations in Algeria, Malta, Yugoslavia and Israel yielded similar results and finally the Russians, in the 1960s, while carrying out tests for the proposed huge Aswan Dam on the Nile, 1250km from its mouth, found a 250m deep gorge cut into granite with the implication that the river bed where it entered the Mediterranean would have been hundreds of metres below present sea-level

So what might have caused such a dramatic fall and what other evidence might there be? There are mountain ranges in southern Spain and northwestern Africa which curve to join each other across the Gibraltar Straits; the region had a long history of instability and there is much evidence supporting the view that on a number of occasions the floor of the Straits was uplifted, thus cutting off periodically the supply of salt water from the Atlantic. The inflow of fresh water could not keep pace with evaporation so the sea began to dry-up; it has been calculated that it might have taken only 1000 years for this to happen leaving a deep, arid plain or playa flat with a few large saline lakes located where the present deeps are, all 3000m below modern sea-level.

Oceanic/open-sea water has an average salinity of 3.5% i.e. 100 grammes of water contain 3.5 grammes of salts in solution, the common elements being sodium, calcium, magnesium, potassium, chlorine with many others in smaller amounts. When the water evaporates salts are precipitated (just like the scale in our kettles), the least soluble coming out first and the most soluble last. If we take a column of water 100 cm high and heat it up (as in the Mediterranean) then the first mineral, calcite, only appears when half the water has gone; the next, gypsum, when 80% has gone and the next, halite (common salt), when only 10% of water is left. The last minerals are precipitated when only 2% of water is left. The minerals deposited are called evaporites.

’Salt’ deposits are known around the Mediterranean but it was only in the 1960s when the Glomar Challenger, an American research ship, was able to drill through 2000m of water into the bottom of the sea to the southeast of Barcelona that evaporites were found and subsequently were found over almost the whole of the sea floor. There are good indications that the sea evaporated almost to dryness.

Above the evaporites are muddy deposits with fossils characteristic of cold bottom waters indicating that the barrier at Gibraltar was breached and the Atlantic flooded in over a waterfall calculated to have been 100 times the volume of the Victoria Falls and 1000 times that of Niagara - perhaps 40,000 cubic kilometres in a year and taking more than 100 years to fill the Mediterranean basin.

And all that and more from looking at rocks !!

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