

to supply typical thin sections and other information in exchange for comparable material.

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Origin of the Keuper Salt in Britain

EXPLORATION for hydrocarbons in the southern North Sea has shown that over a large part of it the Mesozoic rocks are underlain by Upper Permian (Zechstein), containing thick salt layers which have reacted to the overburden load by developing a wide range of halokinetic structures, from salt pillows to diapiric salt plugs^{1,2}. Some of the plugs penetrate the overlying beds to levels high in the Mesozoic and Tertiary rocks, and in some cases approach the level of the sea floor. Seismic profiles show sharp variations in stratal thickness associated with the plugs, commonly indicating a history of movement from at least Lower Jurassic times onwards.

It has been suggested that certain anomalous sedimentary features of eastern England may be related to the erosion of Triassic rocks in North Sea salt plugs¹. Thus the Albian Red Chalk development requires a source of fine-grained ferruginous detritus which could well be from this source, and the two Cretaceous ironstones of east Lincolnshire could reflect erosion of ferruginous Trias. To these may perhaps be added the unique red-bed facies of the Upper Rhaetic of north Lincolnshire and south Yorkshire³.

The salt movements can, however, be shown in some cases to have affected beds as early as the Middle Triassic Muschelkalk, and this has suggested an explanation for the problem of the Keuper salt beds in Britain. It has long seemed to us that the great bulk of sodium chloride in the Keuper associated with minimal quantities of calcium sulphate and other salts precludes direct origin by evaporation of sea water; it must have been derived from pre-existing salt beds. The suggestion that the Keuper salt was derived from normal sea waters, which precipitated dolomite and gypsum in crossing "a broad shelf far to the south-east" (unpublished work of W. B. Evans) is negated by the evidence of Keuper development available to us. No such massive—or even significant—quantities of Keuper dolomite or gypsum are known in the relevant area.

Certain of the north-west German Zechstein salt plugs are known to have reached the diapiric stage in Keuper times⁴, and the same may be true of some of the plugs on the western side of the North Sea. On reaching the surface they would be leached by the rivers or lakes of the Triassic landscape, just as the desert rivers of South Persia are now leaching the emergent plugs of Cambrian salt. A supply of sodium chloride brine would thus become available, almost free of sulphates and carbonates, for subsequent redeposition by evaporation in the deeper parts of an inland basin. Such may be the source for the Keuper salt beds in Britain.

The main British Keuper salt beds are located in the deep Triassic basins of western England, in Lancashire, Cheshire, Worcestershire, Somerset and the Isle of Man.

This limitation may be a function of the basin type, involving rapid subsidence, with consequent heavy deposition and with relatively steep flanks which may be in part fault controlled. Evidence has recently been adduced to show that much of this western area was topographically low in Triassic times⁵. Alternatively, but in our view less likely, the westerly location of the thick salt beds might indicate that the source was more local, and that the Irish Sea basin is not only an important Triassic feature^{6,7} but includes Permian evaporites thick enough to have developed piercement salt plugs which supplied separated halite for the Keuper basins.

Salt beds with only very small quantities of associated gypsum or anhydrite which occur in the Keuper of the North Sea and north-west Germany may also, it is suggested, owe their origin to the process described here.

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PHYSICS

Vacuum Arc Voltage

IN an investigation of the cathode mechanism of the vacuum arc, in a vacuum of 10^{-5} torr, arc voltages were recorded for forty-one different cathode metals. Oscillographic measurements were made at the minimum stable arcing current over a period of 20 sec; values varied from 5 to 25 V. Each arcing voltage consisted of a broad band of noise 2–3 V in width with a well defined lower edge V_L . The quantity V_L was measured for all forty-one elements and used as a parameter for correlation with the solid state properties of the cathode.

It is suggested that a connexion exists between arcing voltage and the plasma frequency ω_p of the electrons in the cathode metal. Should there be a direct connexion, such that

$$eV_L = \frac{h\omega_p}{2\pi} = \frac{h}{2\pi} \sqrt{\frac{sN\rho e^2}{Wm\epsilon_0}} \text{ joules} \quad (1)$$

using m.k.s. units, so

$$V_L = \frac{h}{2\pi} \sqrt{\frac{sN\rho}{Wm\epsilon_0}} \text{ volts} \quad (2)$$

where $\frac{h\omega_p}{2\pi}$ is the plasma oscillation energy of the electrons

in the solid (h is Planck's constant); $\omega_p^2 = \frac{ne^2}{m\epsilon_0}$ gives the

plasma frequency of the electrons in the solid metal cathode (m.k.s.); n = effective free electron density in the metal (per m^3); m = mass of electron in kg; e = charge of electron; N = Avogadro's number; ρ = density of metal (solid state), kg/m^3 ; W = atomic weight; s = number of electrons/atom contributing towards n ; ϵ_0 = permittivity of free space.

Then the experimental results should give information on s —the number of electrons/atom contributing towards the plasma oscillations in the metal.