Isotopic composition of carbonates and sulphates, potash mineralisation and basin architecture of the Nagaur–Ganganagar evaporite basin (north-western India) and their implications on the Neoproterozoic exogenic cycle

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The Nagaur-Ganganagar evaporite basin covers a large part of the north western India in Western Rajasthan. The evaporite bearing Hanseran Evaporite Group (HEG) is the northern subsurface facies variant of the exposed Bilara Group of carbonates. While the Bilara Group is underlain by Jodhpur Sandstone (disposed on top of the Malani acid effusives, dated ~745 Ma), HEG is also underlain by the same sandstones as documented in numerous deep bore holes. South of Bilara outcrops, near Birmania the facies changes to phosphatic carbonates. As documented by Ilyin (1990), this period of the earth history experienced development of narrow rift basins, many of these are repositories of evaporite deposits. The Nagaur-Ganganagar basin located west of the main NE-SW trending Aravalli Range, came into existence due to rejuvenation of Precambrian lineaments, producing horsts and grabens and extensive acid volcanism. This led to the formation of an extensive, shallow marine basin bounded by Jodhpur-Pokaran-Malani ridge in the south, Aravalli range in the east and Delhi-Sargodha-Lohore subsurface ridge to the north and north east. Salt Range in Pakistan and Hormuz basin in Iran are located in the northern extension of this basin (Dasgupta *et al.*, 1988).

The HEG exhibits lateral facies variations and deposition of atleast seven halite cycles alternating with maroon clays, marl, limestone, stromatolitic and foetid smelling OM-rich dolomite and magnesite. The halite (mainly the 2nd halite cycle) is associated with several potash minerals like sylvite, polyhalite, langbeinite sylvinite and carnallite. Analysis of subsurface strata and structural interpretation suggests deepening of the basin towards the central part and in WNW direction due to steep, step-like NNE-SSW gravity faults with their down thrown side deepening progressively towards west. Thickness of the HEG and the number of halite cycle increases from the margin of the basin towards the centre.

Two bore holes (P/47 and P/12) near Lakhasar in Bikaner district with continuous and well preserved cores were logged and studied. The dolomite and the interbedded anhydrite were analysed for carbon and sulphur isotopes. Petrographic studies show widespread diagenetic replacement features in the carbonates, sulphates and gangue minerals. Oxygen isotopic data for the dolomite also show evidences of meteoric water alteration which is documented by the co-variance of several C-O isotopic data sets. On the other hand, C and S isotopic curves show an inverse correlation (Fig. 1), peculiar for this time range and conforms to the similar observations made by the earlier workers. Pronounced increase of $\delta^{34}S$ (mean = 31.6‰) is accompanied by a change in the $\delta^{13}C_{carb}$ values from 2.1 to −8‰. Allowing some compensation for the diagenetic modification of the isotopic values the magnitude of the isotopic shift for both the isotopes is about 7‰. Such an inverse correlation of C and S isotopic curves imply that Neoproterozoic and Phanerozoic exogenous cycles operated on similar modes (Strauss,1993).

Acknowledgements

Financial Assistance from the Department of Science and Technology, New Delhi (ESS/CA/A4-15/45 to DMB) and Deutsche Foshungsgeminschaft (DFG Str.

281/9-1 to HS) and permission of the Geological Survey of India to use borehole cores is thankfully acknowledged. This is a contribution to the aims and objective of IGCP Project -386.

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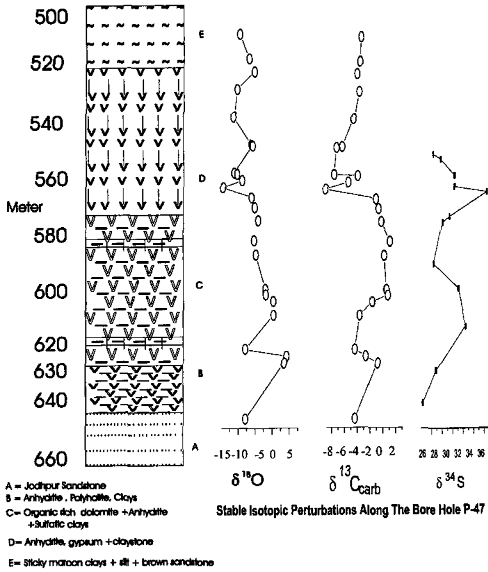

FIG. 1.