of the Kumaun University, Ranjan Dutta, Office of the Principal Scientific Adviser to the Government of India, New Delhi suggested that UCCC has to be intellectually independent and it should stand for the cause of science and the cause of the people; create capability to carry out environmental impact analysis without any fear.

Presenting Compendium Report of the launching workshop of UCCC, L.M.S. Palni, G.B. Pant Institute of Himalayan Environment and Development, Katarmal said that along with autonomy, the Centre should have a regular monitoring and periodic review system. Palni further suggested that demand driven research, data mining within and outside the University, development of bibliography of climate change studies and restructuring of UCCC is needed.

**Bearing of Last Glacial Maxima (LGM) on Sediment Accumulation in Parts of Arabian Sea – Ashish Sarkar (School of Petroleum Technology, Pandit Deendayal Petroleum University Gandhinagar 382 007; Email: ashish29s@yahoo.co.in)**

The west coast of India witnesses a wide range of monsoonal precipitation from the north to the south. While, the annual precipitation in the Kachchh, Gujarat area is around 300 mm, it is nearly 2500 mm in the coastal areas of Kerala. Along with the spatial variation of monsoonal precipitation, there was change in the southwest monsoonal intensity through the Late Quaternary (Sarkar et al. 2000), which must have resulted in a change in sediment accumulation rate along the west coast of India. Continental margins including shelf and slope are very active oceanic regions. In addition to the varying monsoonal precipitation along the west coast of India as mentioned above, seasonally changing monsoon driven-coastal circulation, upwelling, river discharges make the system interesting (Somayajulu et al. 1999). Attempts were made to look at the sediment accumulation rate in off the west coast of India.

In order to understand the climate induced changes in sediment accumulation rate, quite a few offshore cores were raised from the locations with different water depths and from different latitude as well along the western coast of India. Ten ~150 cm long offshore sediment cores from water depths ranging from ~280 m to ~2800 m (between 08°00.7’ N and 21°51.9’ N) in the Eastern Arabian Sea have been retrieved for the present study. The grain size of the terrestrial input in the basin is < 63 µm. The sediment is rich in planktonic foraminifera.

In order to determine the sediment accumulation rates, commonly employed radionuclides viz. naturally occurring $^{209}$Pb (half-life = 22.3 years) and $^{14}$C (= 5730 years), and man-made $^{137}$Cs (= 30 years) have been used for dating the sediments in the cores. While $^{209}$Pb and $^{137}$Cs isotopes could be used to date and hence to determine the sediment accumulation rate during last ~100 years only, $^{14}$C dates could go back to the entire core length equivalent to ~45 ka.

In an attempt to establish the $^{14}$C based chronology in the cores, handpicked foraminiferal separates (250-400 µm) belonging to only “upper water plankton” in the sediment core at an interval of 10-20 cm have been dated using accelerator mass spectrometry (AMS). $^{14}$C ages thus obtained have been corrected for reservoir age and calibrated to calendar ages. These age data in the cores when plotted against the depth below sea floor, it was observed that sediment accumulation rates in between all the sampling intervals are not same resulting in non-linear sedimentation rate.

In the northern core (3104G - 12°49.9’N, 71°14.5’E), barring LGM period, the sediment accumulation rate varies between ~2 cm and ~6 cm/ka. Sedimentation rate during LGM in this core increased to ~13 cm/ka. Similar phenomenon has also been observed in the southern core (3101G - 08°00.7’N, 74°01.3’E), where the sediment accumulation rate barring the LGM period varies between ~3 cm to ~8 cm/ka, and the same during LGM has been ~13 cm/ka.

The point to be noted here is that in both the locations sediment accumulation rates increased by a few fold during the last glacial maxima. Normally the sedimentation rate should increase during enhanced monsoon induced increase in precipitation. In contrary to this, LGM being the period of enhanced aridity, the sediment accumulation rate should have decreased. In reality, in spite of enhanced aridity the sediment accumulation rate in the eastern Arabian Sea increased by few folds.

It has been reported that during LGM the southwest (SW) monsoon in the areas of Indian west coast decreased to about two-third of its present strength, which means, with the depletion in precipitation there was an increase in sediment accumulation rate. In spite of absence of any ‘systematic’ trend in the ratios of Ti/Al, Fe/Al, and Mg/Al in cores 3101G and 3104G Agnihotri et al. (2003) proposed a model in order to address this increment in sediment accumulation in the eastern Arabian Sea. According to their model, ‘wind induced erosion of exposed shelf sediments and its lateral transport during low sea-level stands’ at the time of LGM led to the enhancement of sediment supply in the marine environment. If this model holds good then the sediment accumulated in the marine realm during the low-stand are reworked from the exposed shelf and hence should give rise to older dates. In reality, the sediment deposited during LGM does not show such inversion of dates.

Through an alternative model this enhancement in sediment accumulation
during LGM can be explained by the strengthening of the northeast (NE) monsoon blowing seaward, which is corroborated by the southern extension of the Thar Desert reaching close to the Orsang Basin (22°5' N, 73°35' E), a tributary of the Narmada River (Juyal et al. 2003, 2006). In addition, enhanced aridity induced reduced binding capacity of the soil would have increased the erosion and resulting enhancement of the quantity of the wind borne sediment supply from the ‘Thars’ to the eastern Arabian Sea affecting a two to three fold increase in sediment accumulation rate during LGM.

References

Alex Du Toit Memorial Lecture – P. Krishnamurthy (Geological Society of India, Bangalore; Email:gsocind@gmail.com)


A series of seven (7) stages in sequence have been recognized as a major feature in the life of a magmatic Ni sulphide deposit. These include: (1) Birth of the magma in the mantle source regions due to melting. (2) Development of the magma by ascent in to the crust. (3) Fertilization of the magma by interaction with the crust and early development of immiscible sulphides. (4) Delivery of the magma+immiscible sulphides to a high level in the crust. (5) Growth by concentration of the sulphides during magma emplacement. (6) Nourishment of the sulphides by further flowing magma. (7) Full maturity by cooling and crystallization of the magma and related sulphides.

The theories of chemical and physical parameters constraining these stages are discussed with special reference to three major Ni-sulphide deposits, namely Norilsk, Voisey’s Bay and Kambalda.

‘Modelling of partial melting, followed by magma ascent and early fractionation indicates that unless a magma interacts with its surroundings in a manner to change its sulphur content at sulphide saturation (SCSS) or acquires additional sulphur, it will not achieve sulphide saturation until much of its contained Ni has been removed in early crystallizing olivine. In most cases (e.g. Norilsk and Voisey’s Bay), it is apparent that external sulphur has been assimilated from country rocks and thus these deposits had acquired a low initial R factor. Modelling indicates that ‘subsequent high temperature magmatic upgrading of the initially formed sulphides’ have made them economically viable. The importance of the presence of phenocrysts as well as their packing density has a strong control on the settling of sulphides as a result of their greater density. This places constraints on the origin of net-textured sulphides such as those found in Kambalda. Wetting angles between silicates and sulphides in the presence of silicate magma are high which will prevent sulphides “leaking” out into country rocks into permeable zones or adjacent structures when magma is present. Wetting angles between sulphides and silicates are low when silicate magmas are absent. In such cases, as in the Reid Brook Zone of Voisey’s Bay deposit, surface tension effects are likely to promote escape of magmatic sulphides in to surrounding country rocks.

Once sulphide melt starts to crystallize, its sulphur fugacity controls the composition of the mss and the pyrrhotite that forms from it, which in turn controls the diffusion rates of Ni within the mss/pyrrhotite and the temperature at which pentlandite starts to exsolve. In natural settings, these factors determine the concentration of Ni that will never exsolve from the pyrrhotite as pentlandite, and whether the pentlandite occurs as fine flames or larger, more easily separated, masses. Furthermore, it is only sulphur–rich pyrrhotites that are magnetic; this is a function of the sulphur/metal ratio of the original sulphide liquid, and