

NOTES

“WHERE OIL MEETS GOLD”

“Where oil meets Gold” was the title of a very interesting talk delivered by Mr. Steve Lawrence, Chief Geologist, Exploration Consultants Ltd. U.K., on 1st Dec.97, at the Geological Society of India, Bangalore. This catchy title denotes the joint efforts of petroleum geologists and economic geologists in solving the problem of origin of gold mineralization in the Late Archaean Witwatersrand basin of South Africa (350 km x 200 km) — the largest known gold province which has produced some 45,000 tonnes of gold, almost 1/3 of the gold so far produced in the world.

The origin of gold in the Rand basin has been controversial for decades, with arguments favouring detrital (placer), modified placer and hydrothermal origins. Seven years of detailed research by a group of geologists from University of Leeds, U.K. and Anglo-American Prospecting Services, South Africa, has led them to conclude that the huge gold deposit in the Rand Basin is entirely due to hydrothermal processes and not of placer origin as hitherto strongly believed by economic geologists. Two important publications mark this breakthrough (Nature v. 386, No. 24, April 1997 and Jour.Geol.Soc.Lond. v. 155, pt.1, pp. 39-59, Jan. 1998).

The traditional view favouring placer origin of gold was based on the association of gold with quartz-pebble conglomerate and the presence of rounded grains of uraninite and pyrite both considered to be detrital. This traditional view was further supported by the presence carbonaceous material (‘carbon’) believed to be algal in character. The belief in the absence of any significant post-depositional changes in the rocks of the basin was an added argument in favour of the placer origin of gold of the Witwatersrand.

All these views and beliefs according to the new hydrothermal theory are untenable. The authors of the new theory have demonstrated that the carbonaceous matter occurring in the gold-bearing conglomerates in the form of thin carbon seams and fly speck carbon is not *in situ* sedimentary organic matter but is a carbonaceous mesophase which is the result of hydrothermal alteration of petroleum bitumen. The petroleum bitumen was introduced through fracture conduits into the basin after sedimentation and lithification. Crack-infilling of the uraninite and replacement of uraninite by carbon have also been observed, a fact recorded by many earlier workers. The source rocks for the hydrocarbon are now traced to the intrabasinal Witwatersrand shale units.

The new theory is further strengthened by the recognition of regional structural control of gold mineralisation — both bedding parallel and transgressive structures being present throughout the basin. There are also vein-like hydrocarbon seams cross cutting sedimentary features, with carbon occupying an anastomosing set of bed-parallel fractures. Earlier, these structures were dismissed as of local origin and not of any significance. These structures are now shown to be of tectonic origin related to thrusting from the NW side of the Rand basin.

The proponents of the new theory have recognised pyrophyllite, hitherto believed to be sericite, along mm to cm thin shear planes marked by phyllonites. Pyrophyllite is a product of reaction of acidic hydrothermal solutions with muscovite and quartz of the sedimentary package. Presence of corroded quartz grains is stated as evidence in support of the attack of acidic hydrothermal solutions.

Another fact which lends credence to the new theory is the recognition of a direct relationship of carbon with gold grade. The authors have observed that gold occurs within a few centimetres of hydrocarbon seams and none of over 40,000 gold grains examined occurs in textural sites present at the time of sedimentation. Reduction of auriferous hydrothermal fluid by hydrocarbons is believed to have caused precipitation of gold.

Uraninite hitherto considered to be of detrital (placer) origin is also shown to be of hydrothermal origin, uraninite having grown after phyllosilicates. There is also a strong spatial association between carbon and uraninite. Uraninite-free carbon is uncommon in the Rand basin.

The new theory is very likely to open up possibilities for locating Witwatersrand - type gold mineralization in other parts of the world, though it appears that there is only a remote possibility of finding another deposit of the same magnitude. Conglomerate - quartzite and carbonaceous horizons in Late Archaean greenstone belts and Proterozoic basins have to be reexamined in the light of this new research.

Bangalore

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ASIA'S LONGEST SUBTERRANEAN CAVE IN INDIA

We are aware of the existence of limestone caverns in many parts of India, though a majority of them have not been mapped and published in detail on a large scale. In February 1997 an expedition led by B.D.Karpan Daly, General Secretary, Meghalaya Adventurers' Association (MAA), was able to link up the earlier known four caves (Krem Um Lawn, Krem Kotsai, Krem Um Lawn II and Krem Um Shor) into one, extending about 19 km, located near Jowai in Jaintia Hills district of Meghalaya (*Outlook*, December 15, 1997, p. 82). The one in Vietnam, supposedly 16 km long, was till recently thought to be the longest in Asia.

It is surmised that there are still many unexplored caves in Garo and Jaintia districts of Meghalaya. These are perhaps in the Sylhet Limestone Stage of Eocene. It is hoped that apart from the foreigners who have visited and are visiting these caves to study and map, the earth scientists from the nearby organizations and institutions will do the needful to bring to light the spectacular features like stalactites, stalagmites, drapes or curtains, helectites etc. that are bound to be present in such a long cave.

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MEMORIAL TO JOB CHARNOCK

The editorial "Sad state of the memorial to Job Charnock founder of Calcutta" (Radhakrishna, December, 1997) in *Journal of the Geological Society of India* call for action. The fact that the tombstone of Job Charnock is the "type-stone" of Charnockite from a quarry near St. Thomas Mount, Chennai makes it imperative that the Tombstone of Job Charnock, the founder of Calcutta be protected as a National Geological Monument and an International heritage.

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