mostly unaware of its catastrophic effects unless properly and periodically educated We all know that the education programs and mitigation measures will be kept at a very low profile after few years or decades A question still arises, after 50 or 100 years the DART sensors which are placed at the deep ocean bottom will be working real time? We have more than 3 million fishermen population and few millions of non-fishermen along the coasts Evacuation of large number of people within one or two hours is a major task Hence, forecasting exact location of inundation and its severity is very important Systematic and high resolution inner-shelf bathymetric data is not available with us and with out which the accurate prediction of the area which would be possibly get affected is extremely difficult We certainly need a warning system but if there is one it will not be the panacea to prevent the loss of lives and properties in the sub-continent from the fury of tsunami What we essentially need is, along with the warning system we should *stricto-senso* implement the newly proposed Coastal Zone Management (CZM)

GEOLOGICAL AND GEOCHEMICAL ASPECTS OF THE GULCHERU FORMATION IN THE SOUTHWESTERN MARGIN OF THE CUDDAPAH BASIN AND ITS POTENTIALITY FOR URANIUM MINERALISATION

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Extended Abstract

Geology

Gulcheru Formation (GF) in the Cuddapah Basin (CB) marks the onset of sedimentation after the profound 'Eparchaean' unconformity It non-conformably overlies (Nagaraja Rao et al 1987) the gneisses, schists and younger granitoids of Eastern Dharwar craton In the southwestern margin of the CB, it has a general E-W strike with shallow (8°-15°) northerly dips (Basu et al 2007) GF is conformably overlain by Vempalle Formation

Five lithofacies characterize GF (Basu et al 2007) These in the order of superposition are pink massive quartzite (PMQ), dark brown ferruginous quartzite (DBPQ), grey cross-bedded quartzite (GQ), purple shale-siltstone (PSS) and pitted quartzite (PQ) The lower most unit starts with lensoidal bodies of unsorted epiclastic basal conglomerate (BC) BC, deposited as alluvial fans by debris flows in wadis along the basin margin, may altogether be considered as a different lithofacies On the basis of detailed facies analysis it is established (Basu et al 2007) that in the southwestern margin of the CB, GF shows a transition from initial fluvio-aeolian to later marine regime

GF is traversed by a number of ENE-WSW to ESE-WNW trending strike faults as well as NE-SW trending diagonal, strike-slip faults and is intruded by E-W to ESE-WNW trending dolerite dykes (Basu et al 2007)

Geochemistry

Major oxide geochemical data (N=65) shows that except for PSS all other lithounits have very high SiO2/Al2O3 values (averages for BC 25 63, PMQ 207 25, DBFQ 39 46, GQ 103 49, PSS 3 96, PQ 137 45) compared to sandstones of passive continental margin (SPCM 9 74) as well as Post-Archaean Average Australian Shale (PAAS 3 32) This depicts their higher order of mineralogical maturity due to recycling and/or intense chemical weathering of source rock All lithounits except for BC show very high values of Al_2O_3/TiO_2 (averages for BC 6 47, PMQ 32 21, DBFQ 40 02, GQ 52 94, PSS 40 13, PQ 63 75) compared to PAAS (18 90) as well as SPCM (17 16) In successively younger quartzite horizons Al_2O_3/TiO_2 ratio increases, possibly implying the effect of heavy mineral fractionation or hydraulic sorting

In K_2O/Na_2O-SiO_2/Al_2O_3 bivariate diagram, PSS and to some extent BC show most restricted compositional range, whereas, both of PMQ and PQ have restricted range of SiO_2/Al_2O_3 but show wide variations in K_2O/Na_2O ratio GQ shows wide ranges of both K_2O/Na_2O DBFQ shows

Gist of the lecture delivered on 27 June 2007 at the Geological Society of India, Bangalore negative correlation between SiO_2/Al_2O_3 and K_2O/Na_2O, possibly implying variation in relative proportions of smectite and illite clays. As a matter of fact, in MgO/Al_2O_3 and K_2O/Al_2O_3 compositional field illite is found to be dominant clay mineral with minor amounts of kaolinite and chlorite. Moreover, positive correlation of Al_2O_3 with MgO, LOI, K_2O, Na_2O and CaO implies presence of small amounts of smectite. XRD analyses of some samples substantiate this interpretation.

Trace elemental data of 11 samples indicate that all of PMQ, DBFQ and GQ are depleted in Rb, Cs, Sc, Cr, Co, Hf, Th and SREE with respect to PAAS. Though GQ is depleted in U abundances (0.72xPAAS), both PMQ and DBFQ show enrichment of the order of 2.73 and 3.40 respectively with respect to PAAS. Positive correlation of Ti (0.88), Th (0.78), Sc (0.63), Cr (0.50) and Co (0.89) with Al in the quartzites suggests clay host for them. Moderate correlation of LREEs (0.30-0.49) with Al and negative to low correlation (-0.05-0.19) of HREEs (0.30-0.49) with Al indicate that REE concentration is mainly controlled by heavy minerals with subordinate control of clays on LREEs. In the chondrite normalized diagram both PMQ and GQ show overall REE pattern similar to that of PAAS with small negative europium anomalies (Eu/Eu*) of 0.74 and 0.64 respectively. DBFQ on the other hand shows high positive europium anomaly (1.70).

Although uncertainties exist in interpreting the CIA because of possible mobility of alkali and alkaline earth elements (Wronkiewicz and Condie, 1989), the CIA data of GF (55-71) appear to record moderate chemical weathering of the source rock.

Finer resolution is the essence of stratigraphic subdivision of any sedimentary succession. Sedimentary successions of many Proterozoic basins of India have been subdivided into lowest mapable litho-stratigraphic units (member). However, in case of CB no such attempt has been made till date. From the above discussion, it is evident that each litho-facies of GF has distinct sedimentological as well as geochemical characteristics. All along the southwestern margin of the CB they, except for BC, show remarkable lateral continuity with minor local variations (Basu et al. 2007). Thus, each of them may be considered as separate members. Hence, I propose member status to each of the above mentioned lithounits (Table 1). The locality names have been selected on the basis of the exposure of the most representative section of the respective lithounits.

Uranium Mineralization Potentiality

In general, three factors play important role in epigenetic uranium mineralization. These are (a) presence of a protolith (source rock) with dispersed uranium, (b) remobilization (facilitated by tectono-thermal events) of dispersed uranium and (c) fixation and concentration of the mobile uranyl ions at suitable locales. With reference to uranium mineralization in GF, by and large the fertile younger granite (Closepet equivalent), with fair amount of intrinsic uranium content (average 24 ppm; Umamaheswar, 1997), as a part of basement rock in the southwestern margin of CB is considered to be primary source. Added to this, GF with high intrinsic uranium content (7.07 ppm, N=11), as evident from INAA analyses, might also have acted as a good source of uranium.

Post-sedimentary structural events might have rendered secondary porosity, thereby producing locales conducive for migration and localization of mineralizers within the sediments. Emplacement of basic dykes into the sediments of GF might have helped in raising the geo-thermal gradient, which plausibly generated a convective current into the circulating fluids. The favourable factors, like presence of fertile granitioids in the provenance, high intrinsic uranium content of the siliciclastics and post-sedimentation tectono-thermal activity, have rendered GF as the potential host for structurally controlled vein type uranium mineralization.

Table 1. Proposed subdivision of Gulcheru Formation (in the SW margin of Cuddapah Basin

	Proposed Subdivisoin	Lithofacies	Depositional Environment
Vempalle Formation			
Gulcheru Formation	Rachakuntapalle Member	Pitted quartzite	Barrier beach
	Madyalabodu Member	Purple shale siltstone	Shoreface / Lagoonal tidal flat
	Gandi Member	Grey quartzite	Foreshore to upper shoreface
	Bolaguntacheruvu Member	Dark-brown ferruginous quartzite	Backshore (berm)
	Godu Konda Member	Pink massive quartzite	Fluvio-aeolian
	Parnapalle Member	Basal conglomerate	Fluvial
Basement gneisses, schists and granitoids			

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References

Basu, H, Gangadhran, G R, Kumar, S, Sharma, U P, Rai, A K and Chaki, A (2007) Sedimentary facies of Gulcheru Quartzite in the southwestern part of the Cuddapah Basin and their implication in deciphering the depositional environment Jour Geol Soc India, v 69, pp 347-358

Nagaraja Rao, B K, Rajurkar, S T, Ramalingaswamy, G and Ravindra Babu, G (1987) Stratigraphy, structure and evolution of the Cuddapah Basin In Purana Basins of Peninsular India Mem Geol Soc India, no 6, pp 33 86

Umamaheshwar, K (1997) Annual report for the field season 1996-1997 Project Cuddapah Unpublished Report, AMD, Southern Region, Bangalore

Wronkiewicz, D J and Condie, K C (1989) Geochemistry and provenance of sediments from the Pongola Supergroup, South Africa Evidence for a 3 0 Ga old continental craton Geochem Cosmochim Acta, v 53, pp 1537-1549

CO_2 Science

MILLENNIAL-SCALE CLIMATE CHANGE IN THE EASTERN ARABIAN SEA

A D Singh, D Kroon and R S Ganeshram

The above paper published in the Special issue of Journal of the Geological Society of India on Indian Monsoon (JGSI, v 68, pp 369-377) has caught the attention of scientists abroad and elicited the following comment

"The findings of the study help to demonstrate the global nature of the millennial-scale climatic oscillation that pervades both glacial and interglacial periods alike, and these two aspects of the phenomenon suggest that it likely has an extraterrestrial origin, most probably centered in the Sun The existence of this spatially- and temporally-pervasive climatic oscillation provides strong support for a global Medieval Warm Period and Little Ice Age, which is something climate alarmists are generally loath to acknowledge, for the development and demise of these two extreme climatic states over a period of relative constancy in atmospheric CO_2 concentration suggests that the recently established Current Warm Period may well have nothing to do with the historical rise in the air's CO_2 content but likely everything to do with the unrelated phenomenon that produced the analogous Medieval Warm Period and antithetical Little Ice Age "

(source http //www CO2science org)

THE WORLD'S LARGEST FLYING BIRD

The aerodynamics of the giant bird *Argentavis*, the world's largest bird from the Miocene of Argentina has been studied by Sankar Chatterjee and his colleagues The bird had a large mass (75 kg) and the wingspan of 21 feet, about the size of '*Jatayu*' in Ramayana and was not capable of continuous flapping flight or standing takeoff under its own muscle power Like extant condors and vulutures, *Argentavis* would have extracted energy from the atmosphere for flight, relying on thermals present on the Argentinean pampas to provide power for soaring, and it probably used slope soaring over the windward slopes of the Andes It was an excellent glider, with a gliding angle close to 3° and a cruising speed of 67 kph *Agrentavis* could take off by running downhill, or by launching from a perch to pick up flight speed. Other means of takeoff remain problematic

(source: http.www gesc ttu edu/Fac_pages/chatterjee)