Evolution of Manzanillo batholith Complex: Structural data, thermobarometry and geochronology

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The Manzanillo batholith Complex (MBC) occurring along the south-western shores of Mexico is related to the Latest-Cretaceous convergence between the Farallon and North-America plates. The MBC is composed of metalluminous granodiorite and granite, with a gabbro-diorite core, which intruded into the Cretaceous volcano-sedimentary arc sequences of the Guerrero terrane.

Structural, geochemical as well as SHRIMP U/Pb zircon geochronology data suggest that the MBC is a composite batholith and it was formed by several magmatic bodies. They were emplaced at different depths and different times ranging from 74 to 62 Ma: five Granite Complexes (GCs), a Granodiorite Complex (GrdC) and a Gabbro Complex (GbC).

i) The main rock-type is a medium grain size granite associated with minor granodiorite and porphyry dikes (GrCs). They are typically calc-alkaline and relatively K-enriched. The oldest granitic complex was emplaced 74 Ma ago and the depth emplacement ranging between 6 and 12 km.

ii) Grain coarse Granodiorite Complex (GrdC) shows a discrete internal foliation and it is compositionally homogeneous with LILE enrichment, fractionated LREE with a distinct negative Nb anomaly and flat HREE patterns. It apparently was emplaced at shallow crustal level (< 2.8 kbar) and at 62 Ma ago.

iii) Massive gabbros and minor isolated small cumulitic bodies (associated with brown Am replacing Cpx) and diorite rocks constitute the Gabbro Complex (GbC), which occurres essentially in the central part of the MBC. GbC magmatic textures are preserved apparently in place, but locally subsolidus reactions and plastic deformation are observed. Near the contact between the GrdC and GbC the gabbros are affected by melt infiltrations with a growth of Bt, Qtz, Kfs. Pl presents rounded and corroded rims. GbC is slight older (68 Ma) and deeper than GrdC.

On the basis of field, geochemical and geochronological data we argue that GbC intruded at about 15 km depth and succesively was affected by subsolidus recrystallization and deformation before or during fast uplift. Chemical composition support a fluid slab-related contamination and a tectonic emplacement at shallow crustal levels for these bodies.

High primary productivity in stromatolitic phosphorites from the Paleoproterozoic Aravalli Supergroup

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Paleoproterozoic biogeochemical cycles were fundamentally changed by glaciations and the accumulation of atmospheric oxygen. Higher levels of seawater sulfate and atmospheric oxygen have been inferred from Paleoproterozoic interglacial sedimentary sulfides with sulfur isotope compositions characterized by large ranges of $\delta^{34}S$ values and the absence of mass-independent fractionation (Papineau *et al*., 2007; Bekker *et al*., 2004). Carbon isotope excursions in Paleoproterozoic interglacial carbonates from the Transvaal Supergroup and in post-glacial carbonates on most continents indicate high burial rates of organic carbon and suggest a significant production of atmospheric oxygen (Bekker *et al*., 2001; Karhu and Holland, 1996). Because atmospheric oxygen is primarily produced by oxygenic photosynthesis, these observations suggest enhanced primary productivity during the Paleoproterozoic. This was perhaps modulated by higher nutrient availability in seawater, such as phosphate, which could have resulted from post-glacial greenhouse conditions and accelerated weathering of continental crust.

We present new carbon isotope data from dolomite, carbonate fluorapatite and organic matter in stromatolitic phosphorites from the Paleoproterozoic Jhamarkotra Formation of the Aravalli Supergroup, India. Carbonate fluorapatite from columnar stromatolites is systematically depleted in ^{13}C (-1.8 to -0.2‰) compared to intercolumnar dolomite (-0.3 to +0.6‰). These results suggest late diagenetic substitution in carbonate fluorapatite by HCO_3^- from the oxidation of organic matter. Total organic carbon extracted from these two phases overlaps in ranges of abundance and $\delta^{13}C$ values, but are characterised by unusually heavy $\delta^{13}C$ values up to -15‰. These carbon isotope data may reflect high levels of primary productivity during phosphorite deposition in the Jhamarkotra embayment. No carbon isotope excursion was found in stratigraphically lower and higher dolomites in the embayment, but excursions up to +5‰ exist in contemporary carbonates from nearby localities. Ongoing work with Re and Os isotopes could provide better age constraints for this unique phosphate deposit and relate it to other events of that time. In the context of Paleoproterozoic biogeochemical evolution, these phosphorites appear to record high biological primary productivity associated with post-glacial climate change.