

Sm-Nd CONSTRAINS ON PROTOLITH AGE OF THE ARCHEAN IMATAÇA COMPLEX, VENEZUELA.

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The Archean Imataca Complex (IC) crops out at the NW Amazon Craton in faulted contact with Paleoproterozoic granite-greenstone-gneiss rocks of the Maroni-Itacaiúnas belt. The IC has been considered to be an allochthonous block in view of the presence of southeast-dipping thrusts combined with isoclinal folds, as well as extensive flaser and mylonitic deformations, overprinting the country rocks. Additional tectonic features are seen along the southern edge of the block where multiple faulting and large mylonite zones developed in association with the Guri transcurrent fault (*e.g.*, Kalliokoski, 1965; Ascanio, 1975; Montgomery, 1979; Gibbs and Barron, 1983).

The IC comprises quartz-feldspar gneiss assemblages of probably sedimentary origin, commonly garnet bearing, that include BIF, dolomitic marble and quartzite (*e.g.*, Hurley *et al.*, 1972; Wynn *et al.*, 1993). However tholeiitic amphibolites and calc-alkaline orthogneisses are also present in the Complex (*e.g.* Dougan, 1976; 1977). The latter rocks in the western part of Imataca are extensively affected by migmatite injections and anatexis (devoid of metasedimentary components), the largest mass of which is centered on Cerro La Ceiba (*e.g.* Kalliokoski, 1965). The IC is also cut by a dozen of relatively small plutons (*e.g.*, Encrucijada granite), emplaced between 2.2 and 2.1 Ga ago (Posadas and Kalliokoski, 1967), tectonically related with the Transamazonian orogeny.

Regional metamorphic grade in the IC is mainly amphibolite facies, however mafic and felsic gneisses of granulite grade are widespread in vicinities of Guri dam and to the east of Caroni river (*e.g.*, El Pao, Upata), which has obscured the nature of the protolith (*e.g.*, Dougan, 1976; 1977; Martin, 1974).

Geochronological studies during the 70 and 80 decades have led to the following assessments for the evolution of the IC:

(1) Rb-Sr and Pb whole rocks analyses suggest that the age of the IC protolith goes back to at least 3100 Ma and might be as old as 3700-3400 Ma. The early high grade metamorphism and igneous events represented by gneisses, migmatites (including La Ceiba), and granitoid rocks took place between 2800-2700 Ma ago (Hurley *et al.*, 1968; 1972; 1976; Montgomery and Hurley, 1978; Montgomery, 1979).

(2) U-Pb determinations of zircons from the granulitic gneisses revealed almost complete loss of radiogenic Pb at about 2.0 Ga ago, and were unhelpful in clarifying the primary age of the system (Gaudette *et al.*, 1973). Additional Rb/Sr and Pb-Pb whole rock analyses showed that granulitic facies metamorphism near Guri occurred at approximately 2.0 – 2.2 Ga ago, in some places accompanying deformation by shearing. During these events extensive depletion of U with respect to Pb took place (Montgomery and Hurley, 1978).

(3) ⁴⁰Ar/³⁹Ar plateau dates on hornblende revealed regional cooling of the terrain took place shortly after Transamazonian orogeny, but further reactivation during younger Proterozoic episodes were also suggested by additional ⁴⁰Ar/³⁹Ar dates between 1.7 and 1.1 Ga (Onstott *et al.*, 1989).

Representative geological domains of Imataca comprising amphibolite to granulite facies gneisses, migmatites, amphibolites, as well as the intrusive granitoids were sampled for Sm/Nd and Rb/Sr studies in early 1998, under a scientific agreement established by the CPGeo-USP and SOPEVEN mining company, supported by the Ministerio de Minas y Hidrocarburos of Venezuela. The field profiles were carried out in

quarries and along road cuts and railroads in vicinities of Guri dam, San Felix, Upata, El Pao Ciudad Piar, Ciudad Bolivar, Puerto Ordaz, La Flor, Esmeralda, and La Esperanza-Los Hicoteos. Major goals of the on-going isotopic research at CPGeo deal with characterization of a protolith age of Imataca rocks and the major periods of regional high grade metamorphism in the Archean evolution.

The preliminary Sm/Nd whole determinations (9 data) on different orthogneissic rocks and intrusive granitoids can be interpreted as follow:

1) Most samples yield T_{DM} model ages between 3230 - 2930 Ma and 2820 - 2600 Ma, suggesting that at least two major mantle-differentiation events participated in the crustal evolution. Calculated ϵ_{Nd} ($2.70Ga$) values ranging from -6,1 to +0.8 reveal that crust reworking in Imataca has played an important role in the Neoproterozoic. However we have not found any isotopic evidence that the primary origin of IC rocks goes back to 3700 - 3400 Ma, as it has been postulated by previous geochronological studies (see above).

2) The Sm-Nd age patterns agree with our Rb/Sr analyses (14 data) carried out on gneissic rocks and migmatites. Reference linear arrays using the new Rb/Sr data confirm the major significance in the evolution of both ~ 3100 Ma medium- to high grade metamorphism and ~ 2700 Ma migmatization event, as already shown by most of published Rb-Sr and Pb-Pb dates (see above).

3) Geographic distribution of the T_{DM} ages suggests some crust zonation might exist within IC, but additional isotopic data are needed for further tectonic implications. The oldest T_{DM} age (3230 Ma) was obtained in the high grade terrain near El Pao, whilst a granulite that crops out westward from Guri has a T_{DM} age of 3090 Ma. The Archean protolith was also the major source of Transamazonian granitoid plutons intrusive into the IC, as supported by their T_{DM} ages between 2950 and 2850 Ma. On the other hand, a foliated partly migmatized granitoid located in the northern tectonic limit of Imataca near Ciudad Bolivar yielded a significant younger T_{DM} age of 2600 Ma.

4) Two Sm-Nd determinations on granitoids located to the West of Caura river and to the South of Ciudad Pilar are Paleoproterozoic in age (2290 and 2214 Ma), revealing that Archean continental crust is more restricted than it has been postulated in recent geologic surveys. In any case these two dates are also diagnostic that IC is an

allochthonous block that has been juxtaposed to the Maroni-itacaiunas belt during the Paleoproterozoic.

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