

# THE GEOLOGIC ARCHITETURE OF THE QUADRILÁTERO FERRÍFERO (MINAS GERAIS, BRAZIL) AFTER MULTIPLE TRANSPRESSIONAL AND TRANSTENSIONAL TECTONIC EVENTS

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The Quadrilátero Ferrífero (QFe) is a quadrilateral lineament-bounded region located in the central part of Minas Gerais state along the southern border of the São Francisco craton (Almeida, 1977; 1981). It comprises a gneiss/migmatite basement older than 3.0 Ga (Teixeira, 1985; Carneiro, 1992), an late archaean granite-greenstone terrane and molassic assemblages (Nova Lima and Maquiné Groups) and paleoproterozoic metasedimentary strata (Minas Supergroup, Sabará and Itacolomi Groups and Santo Antonio Formation) (Dorr, 1969). Our field study indicates that the tectonic architecture of the QFe region can best be explained as a consequence of superposition of three major transpressional orogenic cycles with several periods of magmatism, metamorphism, deformation and sedimentation.

## JEQUIÉ OROGENIC CYCLE

The 2.78 to 2.56Ga Jequié orogenic cycle consisted of three tectonic events developed in a transpressional regime with a steeply-dipping N-S-trending flow plane, under greenschist to medium amphibolite metamorphic facies conditions (Carneiro, 1992; Endo & Carneiro, 1996; Endo *et al.*, 1996; Endo, 1997).

The first Early Neoarchaean tectonic event, the Rio das Velhas orogeny, was responsible for a ductile dextral strike-slip transpression regime accompanied by metamorphism of the Nova Lima greenstone strata. During this event, the Bação dome-shaped structure, originally formed by crustal fracturing, behaved as a semi-rigid body during dextral shearing, generating a foliation-triple-point in greenstone sequences comparable to mylonite microstructure. As a result, the Bação dome deformation is partitioned into uplift and clockwise vorticity component. In addition, a strike-slip component along the Rio das Velhas shear belt controlled the ascent and emplacement of granitic magmas into syntectonic NE-SW and N-S-oriented extension fractures. The most important plutons are the Samambaia Tonalite, the Mateus Leme, Ibirité

and Caeté Granodiorite and the Brumadinho Granite. U/Pb analyses of zircon from these plutons yield ages between 2.78 and 2.70Ga (Carneiro 1992, Romano 1992, Noce 1995).

The second tectonic event is characterized by a sinistral strike-slip transpression that running parallel to the strike of earlier formed belt. This event is distinguished by the emplacement of mafic dyke swarm (Sm/Nd isochron yield an age of about 2.66 Ga, Pinese, 1997) along NW-SE-oriented extension fractures and E-W anti-Riedel crustal fractures and possibly by the deposition of the molassic assemblages of Maquiné Group.

In the third tectonic event, the Maquiné orogeny (Late Neoarchaean), earlier NE-SW discontinuities were reactivated by dextral strike-slip transpression and granitic plutons were emplaced along these crustal discontinuities such as the Salto do Paraopeba and Itabirito Granodiorite and the São Gonçalo do Bação Granite. The U/Pb zircon ages of these plutons are between 2.61 and 2.55Ga (Noce 1995, Endo 1997).

## TRANSAMAZONIAN OROGENIC CYCLE

The Transamazonian orogenic cycle consists of two compressional and two extensional tectonic events which alternated during a minimum time span between 2.25 and 1.90Ga related to the Rhyacian and Orosirian periods. These events may be interpreted as two progressive tectonic megaevents evolved under transpressional regime with N-S-trending flow plane. The metamorphic conditions may ranged from greenschist facies to medium amphibolite facies (Endo, 1997).

The first Rhyacian megaevent, the Minas orogeny, was developed under southwestward crustal shortening. It was responsible for the tectonic inversion of Siderian Minas sequences and the syntectonic deposition of Sabará and Santo Antônio rock assemblages and the emplacement of granitoid plutons such as Alto Maranhão, Ressaquinha, Taboões, Ritápolis, Lavras, Itutinga, Brás Pires and others along NE-SW reactivated crustal

discontinuities. This southwestward tectonic shortening event was followed by an southeast-directed extensional tectonic phase (Late Rhyacian) responsible for the generation of dome and pull-apart basin structures of the QFe region, that was probably filled with Itacolomi sediments. The prominent tectonic features developed during this megaevent are: Vargem do Lima and Santo Antônio southwestward-overtaken synclines; dextral displacement of Mineiro shear belt and Jeceaba-Bom Sucesso lineament; Moeda-Bonfim, Souza Neschese, Curral, Engenho and Água Quente dip-slip shear zones; large upright synclines of the QFe region; Bonfim, Bação, Santa Bárbara, Belo Horizonte and Caeté domal structures and metamorphic aureoles.

The second Orosirian tectonic megaevent, the Itacolomi orogeny, is characterized by northwest-directed crustal shortening and thickening and it was followed by the Late Orosirian extensional orogenic collapse phase (Late Orosirian). The main tectonic features are: sinistral displacement of the Mineiro shear belt; formation of the Itacolomi thrust system; geometric reactivation of the Fundão-Cambotas shortening shear belt; tectonic inversion of the southeastern flank of the Curral Syncline; structural imbrication at the Moeda-Curral and Moeda/Dom Bosco-Jeceaba/Bom Sucesso synclines connections; and sinistral displacement along the Jeceaba-Bom Sucesso lineament.

### BRASILIANO OROGENIC CYCLE

The last orogenic cycle of the QFe, the Brasiliano orogeny, consists of two tectonic events developed under regional dextral and sinistral transpressional regime installed in an earlier NE-SW-trending flow plane (Machado & Endo, 1994; Endo & Machado, 1995; Endo, 1997). The older event (Early Neoproterozoic III) is characterized by the development of northwest verging fold-thrust belt in the southern QFe region and by westward tangential and basement controlled deformation in the northern region. The movement of the Bação block to the West promoted the Moeda syncline constriction leading to an east flank inversion by a process involving an upward tectonic escape of greenstone sequences. The late extensional orogenic deformation took place in the eastern QFe region after E-W shortening that resulted in an uplift of basement blocks, east verging folds and normal shear zones (Furquim Shear Zone). Finally, the second Brasiliano orogenic phase (Late Neoproterozoic III) represents a north-south shortening component that produced folds with NE-SW to E-W axial foliation planes and reactivated basement tectonic fabric.

### ACKNOWLEDGMENT

This research was supported by FAPESP grant 93/1830-1 to R. Machado/I. Endo and the authors thank CPq-DEGEO/UFOP and Fundação Gorceix (EM/UFOP) for their financial and logistical support.

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