STRUCTURAL FEATURES ASSOCIATED WITH MAFIC DIKES. EXAMPLES FROM THE ATLANTIC COASTAL BELT OF BAHIA, BRAZIL

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Three fundamental rheological stages can be identified when a magma solidifies within a fissural system: first, a dominantly "liquid" phase, then a "liquid" phase interacting with a solid one, and finally a solid phase. During this sequence, important stuctural features develop, and valuable deductions may be made through their study and interpretation.

This concept has been developed and put to the test on 22 little deformed and altered, vertical to subvertical Precambrian dikes (~1.0 Ga) from two key areas on the coast of the State of Bahia (Fig. 1): Salvador - three dikes, 1.5 m to 22 m thick, striking N140-160 ; Ilhéus-Olivença - nineteen dikes, 0.5 to 20 m thick, striking nearly N90 .

Heat exchange and its effects on the rheology of a system that involves, on the one hand, a mafic magma at high temperatures and,on the other, a rock susceptible to fissuring under a brittle regime which will form conduits for the magma are mainly determined by: temperature differences between the magma and the wall rock; depth of emplacement; mineralogy of the wall rock; chemical composition of the magma, especially the role of volatiles and viscosity; magma volume; the average of endo/exothermic reactions during solidification; and, the duration of heat exchange and solidification processes.

In view of this large number of variables, some simplification is necessary in order to understand the processes involved in the fissure-emplacement-solidification sequence. Crucial phases were selected taking into consideration the proportion of solid and "liquid" at the moment of formation of important features, where "liquid" represents the mobile portion of the magma, even in the presence of a small amount of crystals, and solid represents the immobile material produced during solidification processes.

Three phases were distinguished (Fig. 2): 1) a dominantly "liquid" phase - where the rotation of enclaves from the wall rocks, "dragon´s teeth" markers and chilled margins with associated annealing fractures dominate the setting; 2) a "liquid" + solid phase - where lateral fractures of T-type (extensional) and R, R´(Riedel) types (shearing) appear and are propagated at the interface between wall rocks and chilled margins; 3) a dominantly solid phase - where the brittle regime domain is evidenced by the formation of chilled internal fractures (dilation-contraction internal system), "en échelon" inner fissures, and increasing penetration and size of lateral fractures, ending soon after the consolidation cycle (for details, see GOMES et al., 1988).

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Structural features related to mafic dikes are excellent indicators of the rheological conditions of the geological environment, providing valuable information about: crustal level of magma emplacement as revealed mainly by the contact morphology; direction of magmatic pulses, as indicated by enclave rotation, symmetric T-type fractures, lateral Riedel fractures, and "dragon´s teeth" geometry; conditions of mechanical contrast between magma and wall rocks; superposition (or not) of regional and local stresses, related to internal tension of the magmatic flux beneath the upper, solid part of the dike; relations, usually directly proportional, between dike thicknesses and size of xenoliths and the length and frequency of lateral fractures and intensity of edge deformations; domain of dilation-contraction conditions on the solid system during the brittle regime, as shown by chilled fractures and by the presence of R, R´, P and T-type fissures at the margins of the veined mafic rocks.

Results obtained from the Salvador and Ilhéus-Olivença areas through analysis of internal structural aspects of mafic dikes indicate: 1) Magmatic emplacement at a low to moderate angle (about 30 - 45°) from the SE towards the NW in Salvador and from E to W in Ilhéus-Olivença, as based on lateral fractures and information on enclave rotation. 2) A shallow crustal regime of emplacement in Salvador and shallow to slighthy deeper local situations in the Ilhéus-Olivença setting. 3) Taking into consideration a pre-drift restoration, a possible common locale for the magmatism (but not necessarilv the same source) as indicated by the vectors of the magmatism pulses, may be located near the projected origin of the arrows in Figure 1.

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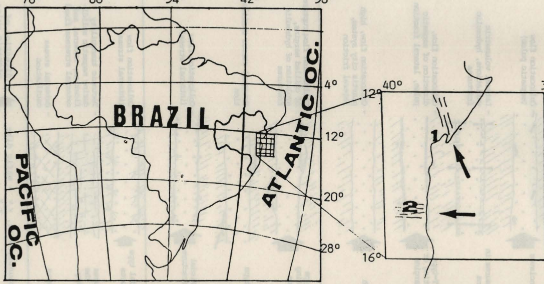

Figure 1 - Locality map of key-areas in South America and the State of Bahia. The numbers and arrows in the inset locate the areas and indicate the direction of emplacement of the mafic dikes as represented by the dotted lines. Area 1 = Salvador; Area 2 = Ilhéus-Olivença.

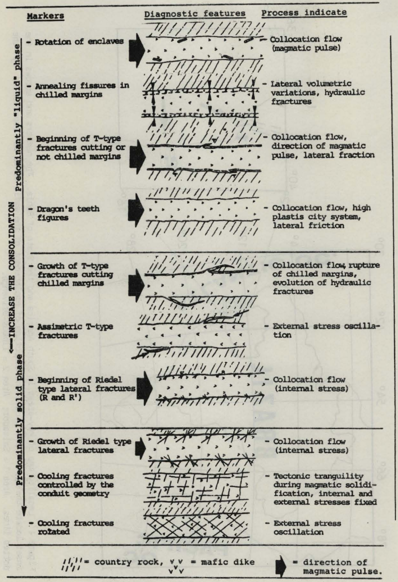

Figure 2 - Summary of structural features related to mafic dikes.