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Journal of South American Earth Sciences 18 (2005) 337–353

Journal of
South American
Earth Sciences

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Kamafugitic diatremes: their textures and field relationships with examples from the Goiás alkaline province, Brazil

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Received 1 March 2003; accepted 1 November 2004

Abstract

Kamafugitic rocks intruded the Precambrian basement and Phanerozoic sediments at the northeast border of the Paraná basin as part of the Late Cretaceous Goiás alkaline province (GAP). Plutonic complexes dominate the north of the province, whereas lavas and pyroclastic rocks prevail in the south. The central GAP is characterized by kamafugitic diatremes, which may crop out continuously for up to 850 m and consist of a central breccia body, surrounded and overlain by lava flows and crosscut by dykes. The breccias contain some special spheroidal juvenile fragments—namely, accretionary and armored lapilli, frozen droplets, spinning droplets, and wrapped fragments—whose textural and mineralogical aspects are described in detail. Irregularly shaped tuff pockets that occur within the breccias contain textures and structures similar to those of subaerial surge deposits and formed in confined, high gas to solid + liquid ratio domains in the conduit. Diatreme emplacement affected the country rock through thermal metamorphism, development of columnar jointing, and formation of peperite-like mixtures. There is no evidence of phreatomagmatic activity in the diatremes, and CO_2, rather than H_2O, seems to have been the major volatile component of the kamafugitic magmas. This finding implies that features such as accretionary lapilli and peperites are not exclusively associated with H_2O-dominated processes.

Keywords: Breccia; Kamafugite; Lapilli; Peperite; Surge

1. Introduction

Most kamafugites and kamafugite–carbonatite volcanic occurrences are either composed of or associated with pyroclastic rocks, as in Uganda (Sahama, 1974), Italy (Stoppa, 1996; Stoppa and Cundari, 1998; Stoppa and Principe, 1998), Germany (Keller, 1985; Riley et al., 1996), and the Alto Paranaíba igneous province (Gibson et al., 1994, 1995; Sgarbi et al., 2000) and Goiás alkaline province (GAP) of central Brazil (Gaspar and Danni, 1981; Moraes, 1988; Danni et al., 1990; Junqueira-Brod et al., 1999; Sgarbi et al., 2000). However, little attention has been paid to their unique textures, fabric, and field relationships.

In southern Goiás state, kamafugitic rocks intrude both the Precambrian basement and the Phanerozoic sediments of the northeast margin of the Paraná basin to form part of the Late Cretaceous GAP (Fig. 1). Many of the kamafugite magmas were emplaced as diatreme structures, the description of which is the main subject of this article.

2. Geological setting

During the Cretaceous, a series of alkaline provinces formed around the margins of the Paraná basin, including the GAP (Gaspar et al., 2003). Older regional-scale structures, such as the Bom Jardim de Goiás arch, an anticline with a S80°W-plunging axis (Pena, 1974), and

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doi:10.1016/j.jsames.2004.11.002

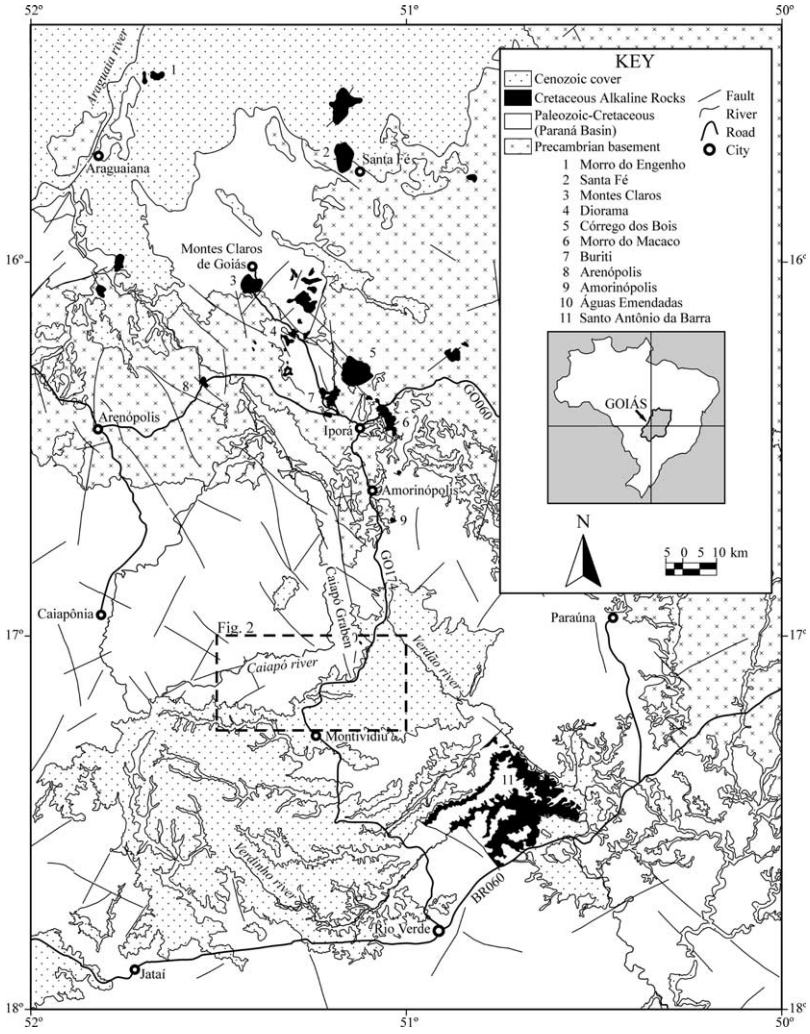

Fig. 1. Simplified geological map of the Goiás alkaline province (GAP), modified from Lacerda Filho et al. (2000).

the Transbrasiliano lineament, a set of NE-trending transcurrent faults (Schobbenhaus Filho et al., 1975), appear to have played important roles in the ascent of alkaline magma in this region.

The GAP occupies a N30°W-elongated area of approximately $250 \times 70\ km^2$ (Fig. 1) and coincides with a well-defined trend of basement faults. Late Cretaceous rift tectonics affected the central northern portion of the province to form the Caiapó graben (Almeida, 1983), a major geomorphologic feature consisting of subparallel N–NW faults that separate half-graben blocks (Mamede et al., 1983).

A wide variety of petrographic types is associated with GAP magmatism, including intrusive, subvolcanic, and volcanic products (Bez et al., 1971; Danni, 1978; Barbour et al., 1979; Gaspar and Danni, 1981; Danni and Gaspar, 1992; Danni et al., 1992). The northern portion of the province is dominated by plutonic bodies, whereas in the south, lavas are the most common emplacement mode. The central portion is characterized by the predominance of diatremes, most of which crop out on the escarpments of the Caiapó graben.

Among the main plutonic bodies in the northern part of the province are the mafic-ultramafic alkaline Santa Fé (Barbour et al., 1979), the Córrego dos Bois and Morro do Macaco (Danni, 1978), and the Fazenda Buriti (Cerqueira and Danni, 1994) complexes. Typically, these are concentric, zoned intrusions composed of peridotite, pyroxenite, gabbro, and syenite. Dykes of various compositions, including lamproites, syenites, trachytes, and alkaline picrites, cut both the intrusions and the country rock. Alkaline picritic dykes, sills, and plugs are scattered in the northern part of the province and believed to represent the parental magma for the main plutonic complexes (Danni et al., 1992; Danni, 1994).

The alkaline–carbonatite Santo Antônio da Barra subprovince (Gaspar and Danni, 1981) is located in the southernmost part of the GAP and comprises volcanic rocks of kamafugitic affinity (Sgarbi et al., 1998) emplaced as lava flows that alternate with rare pyroclastic deposits. Associated late dykes and plugs include fourchite, melamonchiquite, phonolite, and trachyte (Gaspar and Danni, 1981). Hasui et al. (1971) obtain a 85 Ma K–Ar age for