XENOLITH-BEARING GRAPHITIC DIKES IN THE RONDA HIGH-TEMPERATURE PERIDOTITE INTRUSION

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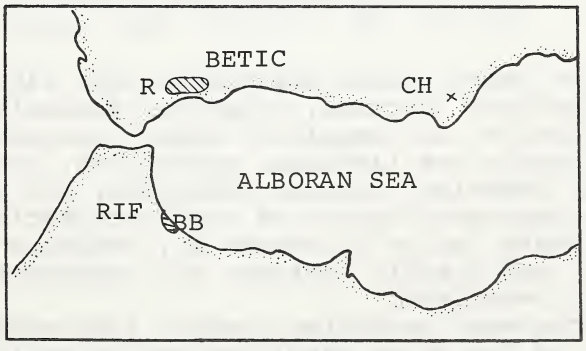
Introduction

The Serrania de la Ronda peridotite intrusion is located on the south coast of Spain within the deformed, internal zone of the Betic-Rif orocline (Fig. 1). The intrusion is on the crest of one of two narrow ridges of high density material, which lie along the margins of the Alboran Sea (Bonini et al., 1973). The southern ridge surfaces as the Beni Bouchera high-temperature peridotite intrusion in Morocco. Unlike peridotite massifs of the ophiolite association, the Ronda and Beni Bouchera peridotites are not overlain by pillow lavas and gabbros. Both ridges intruded thick sections of sialic rocks between late Triassic and Miocene times. The Ronda massif, which is surrounded by marbles, hornfelses, and gneisses, is thought to have intruded the crust at more than 1000°C (Loomis, 1972).

Fig. 1. Localities mentioned in the text.



Key: R = Ronda Massif
CH = Cerro del Hoyazo
BB = Beni Bouchera Massif

The Ronda intrusion is 85 to 90% peridotite, and also contains a variety of mafic sheets and felsic dikes. Field relations and chemistry suggest that the mafic sheets, which vary from garnet pyroxenites to olivine gabbros, formed by partial fusion of mantle rock (Dickey, 1970). The origins of the felsic rocks are obscure: some may be indigenous to the intrusion, others may be related to exotic magma systems, and still others may have been formed by assimilation and fusion of crustal rocks.

This paper describes a particularly interesting group of garnet-bearing quartz diorite dikes in the western part of the peridotite body, which contain extraordinary quantities of graphite, a large assortment of accessory minerals, and a variety of xenoliths.

Field Relations

The graphite-bearing dikes (5 to 150 cm thick) cross-cut all layering and foliations in the peridotite. They have not yet been observed in the adjacent country rocks; however, volcanic rocks of similar mineralogy (but containing little graphite) have been described among Neogene limestones of Cerro del Hoyazo (Zeck, 1968) (Fig. 1). The Ronda dikes are dark gray, fine grained, and in places, vesicular. Typically the dike margins are not chilled, but the contacts are sharp and in some dikes the concentration of graphite increases markedly (to 100%) at the contacts. Textures vary from homogeneous to heterogeneous. Some dikes contain no inclusions; others are laden with a mixture of rounded serpentine, peridotite, gabbro, and gneiss xenoliths and angular fragments of white quartz. The latter are probably derived from shattered quartz veins which issue from some dikes. Most of the xenoliths are represented in the peridotite massif or among the country rocks.

Petrography

The major constituents are plagioclase (40-90% An), quartz, hypersthene, biotite, graphite, almandine-rich garnet, cordierite, and amphibole after hypersthene. Accessory minerals are ilmenite, pyrrhotite, pentlandite, chalcopyrite, cubanite, zircon, hercynite, and apatite.

The heterogeneous varieties are characterized by high graphite contents (up to 16 weight %), graphite-enriched dike margins, and chaotic textures with abundant crystal fragments and xenoliths.

The homogeneous varieties contain less graphite (about 5 weight %) and few or no xenoliths and crystal fragments. The textures are uniform with intergrown, xenomorphic crystals. Some specimens show weak preferred orientation of quartz, plagioclase and biotite. Blades of graphite are disseminated throughout.

Carbon Isotopes

Stable carbon isotope ratios of graphites from these dikes range from -20.8 to -24.1 0/00 (expressed as δC^{13} relative to PDB). Similar values are reported for reduced carbon from chondritic meteorites and terrestrial igneous, metamorphic and sedimentary rocks. These data are, however, quite different from δC^{13} values reported for diamonds (-3 to -8 0/00) (Schwarz, 1969).

Discussion

Mineralogical, chemical and geological evidence indicate that the garnet-bearing, quartz diorite dikes in the Ronda high-temperature peridotite intrusion originated by fusion of sialic crust or by contamination of magma with sialic crust. This process may have occurred during the intrusion of the mantle-derived peridotite. Crystallization of the gas-charged magmas at depth resulted in unusual graphite concentrations which are not observed in volcanic rocks of otherwise similar mineralogy at Cerro del Hoyazo.

References

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