27.2. PETROGRAPHICAL STUDY OF "ACOUSTIC BASEMENT" AND ASSOCIATED BRECCIA AT SITE 121 – WESTERN ALBORAN BASIN: A COMPARISON WITH THE BETICO-RIFEAN BASEMENT

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ABSTRACT

Fifteen slides have been cut both in "acoustic basement" and pebbles from the associated sedimentary breccia at Site 121 (western Alboran Basin). Observed facies (mostly cordierite leptynites and alumino-silicate granites, together with sharp single crystals of brown spinel extracted from peridotites) come from petrographical associations very similar to those described in the Betico-Rifean metamorphic basement, particularly in its lower unit (Monte Hacho/Blanca Unit).

INTRODUCTION

The western part of the Betico-Rifean inner zone, in the vicinity of Site 121 (Figure 1), is essentially composed of peridotites and overlying metamorphic rocks. Two main units have been described (Buntfüss, 1970; Didon *et al.*, in press; Dürr, 1967; Kornprobst, 1962, 1971; Mollat, 1968) as follows:

1. The Monte Hacho/Blanca lower unit with the following association: peridotites (base), low pressure granulite facies rocks (cordierite leptynites and marbles), and gneisses and mica schists (top).

2. The Filali-Beni Bousera/Casares upper unit, including from bottom to top: peridotites, high pressure granulite facies rocks (kyanite bearing kinzigites), and gneisses and mica schists.

Cordierite leptynites from the former clearly show secondary assemblages, with primary garnet sometimes present as scarce and minute relics.

The petrographical study of both "acoustic basement" and associated sedimentary breccia at Site 121, leads to a comparison with the rock types that outcrop on either side of the Straits of Gibraltar, on the banks of the Alboran Sea.

PETROGRAPHY

"Acoustic Basement"

Three slides from rocks supposed to belong to the acoustic basement have been studied.

1. **Core Bit 1**: All the rock is strongly altered. Subidiomorphic plagioclases (An=35) are associated with large, fully transformed cordierite crystals, with inclusions of deep green spinel and prismatic sillimanite. Ore minerals are abundant; quartz is scarce. Secondary phases often mask this assemblage, mostly biotite/quartz intergrowths with static development, which probably represent K-feldspar and sillimanite destabilization.

Similar but unaltered rocks occur as numerous discrete pebbles in the breccia (see below).

2. **Core Bit 2**: Showing granoblastic texture, this rock is strongly altered. Xenomorphic quartz is abundant and associated with idiomorphic cordierite and probably plagioclase, both being replaced by mica-rich assemblages. Fibrolite is present. A common secondary phase is red brown biotite, sometimes chloritized, and white mica, crystallizing at the expense of cordierite. A small relic of garnet is present in cordierite.

Exactly similar rocks occur among the "gneiss du Monte Hacho" at the eastern part of the Ceuta Peninsula.

3. **Core Bit 3**: The texture is typically granitoid quartz with subidiomorphic crystals. Quartz is granular but with interstitial apophyses. The mineralogical composition is granitic. It contains high temperature, finely perthitic orthoclase, twinned acidic andesine, and quartz. Accessory minerals are red brown biotite, altered cordierite, and fibrolite. Interstitial yellow green tourmaline is present, and muscovite is secondary.

Similar samples have been found in the breccia (see below). This rock type occurs commonly as thin dikes in the metamorphic and ultrabasic bodies of the Betico-Rifean basement.

Breccia

The breccia is made up of numerous pebbles and single minerals in a calcareous cement containing biogenic material.

Pebbles

Eleven sections were cut. The following five rock types (showing sections cut) were found: (a) altered kinzigite (one section); (b) cordierite leptynites (five sections); (c) labradorite gneiss (one section); (d) phlogopite marble (two sections); (e) aluminosilicate granites (two sections).

1. Kinzigite is fibrolite bearing, with residual garnet, altered cordierite, red brown secondary biotite, graphite, and quartz.

2. Cordierite leptynites are very similar to Core Bit 1, but are generally unaltered. Essentially, they are made of Ca-rich andesine and twinned cordierite (with lamellar and cyclic twins). They also contain prismatic sillimanite and deep green spinel; some also include potash feldspar. Sometimes relic garnet is included in cordierite or feldspar. One can interpret these assemblages as a result of the reaction: garnet + sillimanite + quartz = anorthite + cordierite + spinel. This is characteristic of the Monte Hacho/Blanca Unit. Biotite and muscovite are secondary phases.

Figure 1. *Position of the main units in the western inner zone of the Betico-Rifean belt. Star indicates the location of Site 121. Black: Filali-Beni Bousera/Casares Unit. Striped: Monte Hacho/Blanca Unit. Dotted: Ghomarides and Malaguides, sedimentary units. (In Spain, the relationships are simplified and provisional.) Data from Buntfuss (1970), Didon* et al. *(1972), Durr (1967), Kornprobst (1962, 1971) and Mollat (1968).*

3. Labradorite gneiss shows essentially subidiomorphic plagioclase (An 50 to An 60), xenomorphic potash feldspar, and red brown biotite; quartz is scarce. Ore minerals and rutile needles are accessory phases. Similar rocks are known at Ras Tarf Cape, Filali Unit.

4. Coarse grained marble contains large phlogopite blades, associated with serpentinized crystals (altered forsterite (?) or humite (?)). This is often seen in the marbles of the Blanca Unit.

5. Alumino-silicate granites are texturally identical with Core Bit 3, showing, however, two assemblages: (a) quartz-feldspar-biotite-cordierite-fibrolite, and (b) quartz-feldspar-biotite-cordierite-andalusite. Cordierite is generally unaltered, with cyclic twinning, and andalusite, as idiomorphic crystals, is generally zoned with a pink colored center.

A sequence of kyanite bearing, sillimanite bearing, then andalusite bearing granitic dikes cuts the basement (ultrabasic gneisses) at Beni Bousera (Kornprobst, 1971).

Single Minerals

Quartz is abundant (as generally sharp grains) together with chlorite, biotite, and muscovite. Numerous glauconite pellets are also present. Other phases are scarce, but may be particularly significant; especially:

1. **Garnet** as sharp pink crystals. Refractive index and unit cell, depicted (after Winchell, 1958) in Figure 2, show close similarity with relic garnet from cordierite leptynites occuring in the Blanca Unit.

2. **Clinopyroxene** as yellowish green prisms. It has a particularly high refractive index (n_g = 1730 ± 0005). It is thus similar with the ferro-salite occuring in numerous pyroxenites and in quartz pyroxenites found as lenses and layers in gneisses and mica schists from Betico-Rifean basement.

3. **Spinel** as sharp grains. It is present with the following aspects: (a) deep green spinel similar to spinel from cordierite leptynites, and (b) deep brown or red brown spinel; with characters (coloration, a and n) identical to those of picotites present in peridotites from Blanca and Beni Bousera Units (Figure 3).

CONCLUSIONS

The study of both "acoustic basement" and breccia at Site 121 (Alboran Sea) shows a variety of samples and single minerals from metamorphic rocks which are very

Figure 2. *Composition of pink garnets extracted from the breccia (stars), as determined by cell parameter and refractive index measurements (Winchell, 1958); comparison with garnets extracted from different rock-types of the Betico-Rifean inner zone (Kornprobst, 1971, and unpublished data).*

similar to those occurring in the western part of the Betico-Rifean basement, and particularly with those from the Monte Hacho/Blanca lower unit (Figure 1). The presence of sharp red brown picotite in the breccia indicates the proximity of ultrabasic (peridotitic) outcrops. As in the case in the Blanca Unit, cordierite leptynites would be closely associated with these peridotites whereas in the Beni Bousera Unit, peridotites are found with kyanite-bearing kinzigites.

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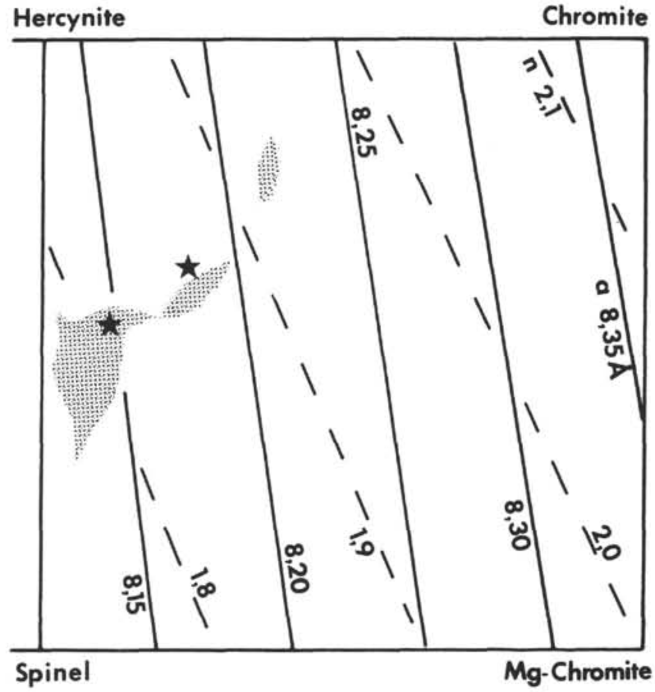

Figure 3. *Composition of deep-brown and red brown spinels extracted from the breccia, determined by cell parameter and refractive index (Deer* et al., *1962). Comparison with spinels extracted from Beni Bousera ultrabasic rocks (dotted area; Kornprobst, 1969).*

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