THE HERCYNIAN DIASTROPHISM IN THE BETIC OF MÁLAGA, SE SPAIN: A DISCUSSION

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ABSTRACT

Arguments for and against a hercynian diastrophism in the Betic of Málaga (especially of the Vélez Rubio region) are briefly discussed. It is concluded that the transition in facies, from Paleozoic turbidites to a Permo-Triassic alluvial fan, and the contrast in detritus of the Paleozoic and Permo-Triassic sediments favour the hypothesis of a hercynian diastrophism.

INTRODUCTION

The Betic of Málaga, the highest nappe of the alpine structural stockwork of the Betic Cordilleras, is composed of unmetamorphosed to slightly metamorphosed sediments of Silurian to Oligocene age (a review is presented by Egeler & Simon, 1969). In the vélez Rubio region these sediments were sligthly folded or tilted in Middle Eocene time (Geel, 1973; p. 68) and repeatedly thrusted towards the SE and the S in Aquitanian or even younger Miocene times. Here, the alpine diastrophism resulted in a great number of thrust masses which can be grouped in four units (Roep & Mac Gillavry, 1962; Roep, 1972). The lowest unit, the Peña Rubia – Casolidad unit, is sligthly touched by alpine kinematic metamorphism: red pelites of Permo-Triassic age often have a slaty or even phyllitic aspect. The red pelites in the other units have a shaly and more crumbly appearance (Roep, 1972: p; 242).

THE HERCYNIAN PROBLEM

The existence of a hercynian diastrophism in the Betic of Málaga was accepted by most authors without much discussion (cf. review in Simon, 1963: p. 51-55). In a recent paper Geel (1973: p. 32, 41, 143, 144) concludes that a hercynian folding phase could not be demonstrated in the Vélez Rubio region and that such a phase is hardly possible. Her conclusion is based on the following arguments:

- An angular unconformity between the Paleozoic Piar Formation and the Permo-Triassic Saladilla Formation could nowhere be demonstrated, as the original contacts are destroyed by alpine movements.
- The more intense tectonization of the Piar Formation with respect to the Saladilla Formation can be explained by a difference in competency. The more so as fold-axes and strikes of axial planes in the Piar Formation have an alpine direction (here WSN-ENE).
- A pre-alpine metamorphism cannot be proved.
- The youngest member of the Piar Formation is in contact with the Saladilla Formation for at least 10 km.

Although no definite proof can be given, I am of the opinion that the evidence turns the balance towards a mild hercynian diastrophism, on account of 1) contrasting facies and detritus content; 2) tectonic style and 3) degree of metamorphism between Piar and Saladilla Formations.

1) Facies and detritus. The strongest indication for a hercynian diastrophism is afforded by the facies and detritus contrast between the Piar Formation and the Saladilla Formation. The bulk of the Piar Formation comprises marine turbidites (olive-green greywackes), with some intercalated slide conglomerates. The youngest member, the so-called Marbella conglomerate member is a slide conglomerate or olistostrome with huge blocks of blue crinoidal limestone of Visean age. The thickness of the Piar Formation is estimated to be of the order of 500 m.

The Saladilla Formation (Roep, 1972) consists mainly of continental red beds. The formation starts with a coarse-grained alluvial fan, grading into river deposits, which in turn give way to lake or shallow sea sediments with algal mats. The thickness of the clastic deposits below the algal mats is at the most 575 m, generally less than 300 m. The maximum grain-size of terrigenous components (usually quartz) is 17 cm. At the base of the formation 11 out of 53 stations have a mean maximum pebble size (10 largest pebbles) between 9 and 13 cm (Roep, 1972: fig. 4).

The flow direction in the fluviatile sandstones is roughly from S to N (not corrected for eventual large scale alpine rotations in the horizontal plane). The flow direction and the alluvial fan point to a mountainous area to the south. The

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distance between the place of deposition and the mountains can be estimated, using the graphs of Pelletier (1958). This distance is more than 16 km for a mean maximum pebble size of 13 cm; 50 to 60 km for 11 cm and 60 to 80 km for 10 cm. Thus the mountain area in Saladilla times was situated several tens of kilometres towards the south.

The sandstones at the base of the Saladilla Formation are typically quartzose, almost devoid of feldspar. Phyllitic debris may comprise up to 7% of the detritus; fragments of metasiltstone and metasandstone up to 6%. Apart from dubious siltstone and radiolarite fragments, no fragments of the Piar Formation were identified with certainty. The phyllitic debris indicates that epimetamorphic rocks were exposed, as is also indicated by lateritic impregnation of part of these fragments.

In the higher part of the formation towards the fined grained fluviatile sandstones, a progressive shift is seen from phyllitic fragments towards feldspar grains: up to 8% of feldspar (orthoclase, microcline, albite, but also sanidine). This suggests erosion of more gneissic-granitic mountains, either the metamorphic core of a "Schiefer Hölle", or some older more remote area. The sanidine probably suggests volcanic activity.

The detritus of the immature Piar greywacke is in great contrasts with that of the quartzose Saladilla formation. In the Piar Formation phyllitic debris is subordinate to that of higher metamorphic rocks, viz. gneisses and schists. The feldspar in the greywackes is mostly albite. The presence of limestone pebbles of late Famennian and early Carboniferous age in the greywackes (Geel, 1973) points to palaeozoic movements as do the huge Visean limestone blocks in the Marbella conglomerate member.

According to de Booy (1966) – see also de Booy, 1965, written comm. Beticum commissie; de Booy and Egeler, 1961, – retrograde metamorphic rock fragments and plutonic rock fragments without microcline in Paleozoic flysches, such as the Piar Formation, point to derivation from pre-Silurian metamorphic rocks. Microcline and fresh biotite in post-Paleozoic sediments such as the Permo-Triassic Saladilla Formation point to derivation from presumably hercynian rocks. One of the gneiss boulders of the Marbella conglomerate yielded a radiometric age of 535 ± 75 m.y. (Soediono, 1971).

It seems difficult to explain the strong contrast in facies and detritus between the Piar and Saladilla Formations without the hypothesis of a hercynian diastrophism. Epeirogenic movements alone could account for the Permo-Triasssic mountains. In that case, however, non-metamorphic debris from the Piar Formation would be expected in the Saladilla Formation. Also the facies transition from deep marine (between Silurian and early Carboniferous – 80 million years – all preserved sediments were deposited below wave base) to continental red beds, without a sign of intermediate facies – either shallow marine or deltaic – seems too abrupt for mere epeirogenic movements. The phyllitic, metasiltstone and metasandstone fragments in the Saladilla Formation, indicate an other source area than in Carboniferous times and probably point to more than epeirogenic movements.

2) Tectonic style. More difficult to evaluate are the differences in the tectonic style and metamorphism between Paleozoic and post-Paleozoic sediments. They may also reflect differences in competency during the severe alpine tectonization. Most fold-axes and axial planes in the Piar Formation indeed have an alpine direction (NE-SW in Xiquena area). The tectonic style however, is quite different from that of the Permo-Triassic Saladilla Formation. The latter formation nearly always faces north in steep or nonnal position; the former is much more faulted and folded. Accordion-type folding is often observed on a metre to millimetre scale. In the Xiquena area 9 beds out of 31 lie in reversed position.

The main argument put forward by Geel (1973) against a hercynian diastrophism is the occurrence over at least 10 km of the youngest member of the Piar Formation (the Marbella conglomerate member) in contact with the Saladilla Formation. This fact is not an argument against a hercynian diastrophism, but an argument for the stratigraphical order. The Marbella conglomerate folded or not, where present, should always be in contact with the Saladilla Formation. However the Marbella conglomerate is not present below the Saladilla Formation in all units. It is found exclusively in the Castillos unit (Roep & MacGillavry, 1962, p. 423; Geel, 1973; p. 145), where it occurs locally. This distribution cannot be explained by alpine movements alone. Either the Marbella conglomerate was not universally present in the Piar Formation or hercynian movements and subsequent erosion caused an uneven areal distribution.

3) Degree of metamorphism. The pelites of the Piar Formation mostly have a slaty appearance, even where the pelites of the overlying Saladilla Formation are shaly and without sign of metamorphism.

CONCLUSION

The arguments of Geel (1973) cannot be used for or against a hercynian diastrophism. Although definite proof is lacking, the arguments of contrasting facies and detritus content and to a lesser degree of contrasting tectonic and metamorphic appearance suggest that a mild hercynian diastrophism affected the Piar Formation in het Velez Rubio region.

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