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**SOUTH ARMORICAN SHEAR ZONE AND CONTINENTAL FIT  
BEFORE THE OPENING OF THE BAY OF BISCAY \***

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—The relative position of continents prior to the opening of the Bay of Biscay can be correctly deduced from reconstruction of the Ibero-Armorican belt only if the extent of the Late-Hercynian horizontal displacement along the south Armorican shear zone and perhaps also along the north Pyrenean fault can be determined. —

Geological similarity between Hercynian zones from Brittany and the Iberian Peninsula has led various authors [1–3] to propose that these zones were once continuous. Bard et al. [3], for example, reconstruct the Hercynian Ibero-Armorican belt to find the position of the Iberian peninsula before the opening of the Bay of Biscay (150 to 200 my ago). They assume continuity of Hercynian structures of the Armorican massif over hundreds of kilometers across the continental shelf. This supposes that Late or Post Hercynian horizontal displacements have not significantly modified the original framework of the Hercynian massif. The purpose of this note is to discuss, on the basis of new results, the importance of the main Late or Post Hercynian horizontal movements which have taken place in Brittany and on the adjacent continental shelf and their implication for the fit of continents based on the reconstruction of the Ibero-Armorican belt.

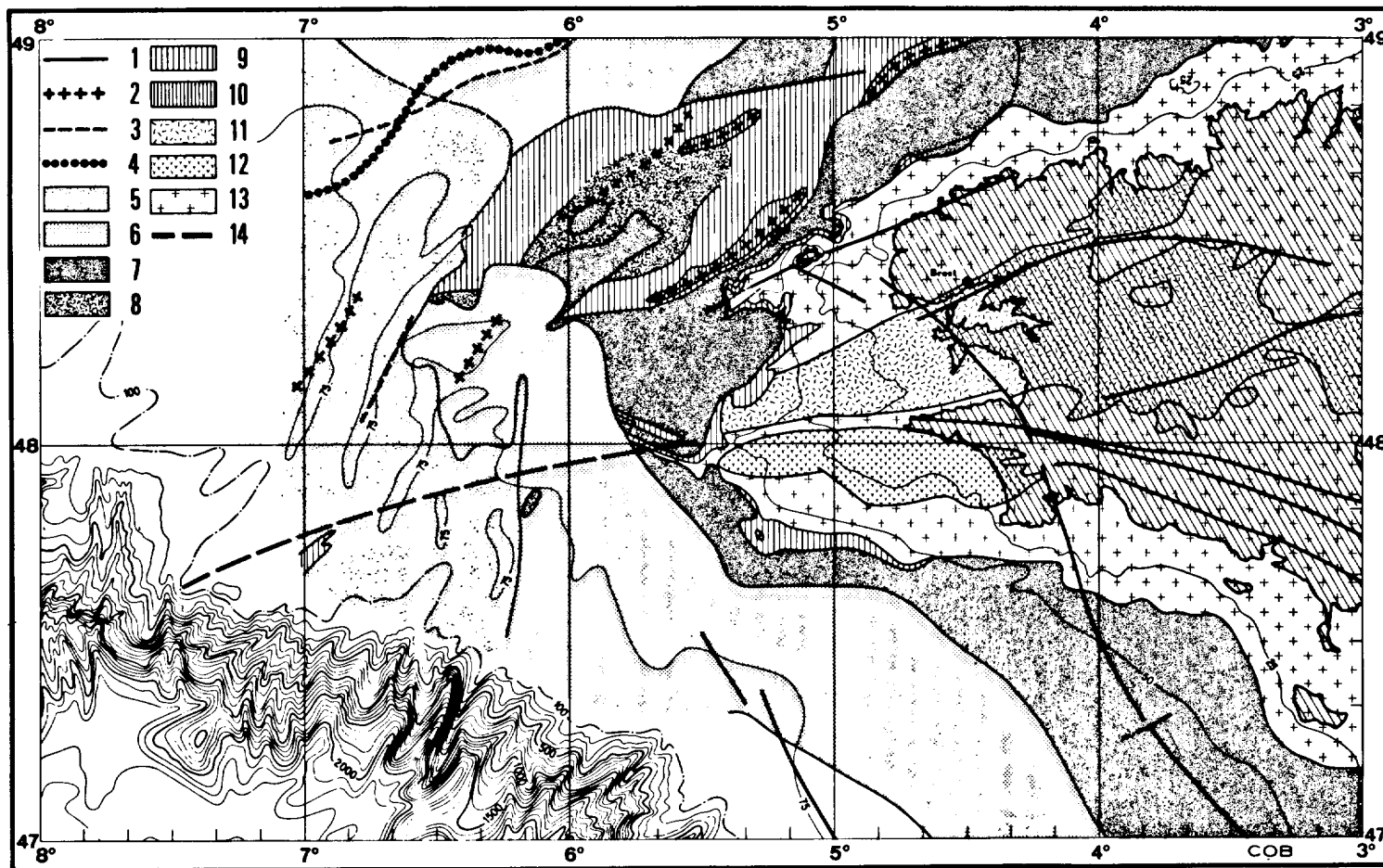
The principal horizontal movements which may have affected the Ibero-Armorican belt after the main Hercynian orogeny are those which have occurred during Late Hercynian time along the south Armorican shear zone [1, 4]. The south Armorican shear zone, which is an important Late Hercynian feature (figs. 1, 2), is roughly parallel to the main structural units in Brittany. The horizontal motion associated with the

shear zone could be several tens of km [5] or even hundreds of km [6].

Recent seismic reflection and rock coring studies at sea [7–11] show that two major geological features of the Armorican massif can be followed up to  $5.5^{\circ}$  longitude west (fig. 1). The granito-gneissic dome of the Léon certainly extends seaward with the same NE-SW trend up to  $5.3^{\circ}$  longitude west and the “Chaussée de Sein” which marks the marine prolongation of the south Armorican shear zone extends at least up to  $5.5^{\circ}$  longitude west. The Paleozoic central Armorican zone, which is located between the two preceding units, disappears at  $5.5^{\circ}$ W and does not exist south of the shear zone. In addition, the NE-SW metamorphic units of the Léon come nearly into contact with the E-W or ENE-WSW shear zone at  $5.5^{\circ}$ W and seem to be cut by the probable prolongation of the shear zone (fig. 1). This suggests that the south Armorican shear zone is a strike-slip fault, since its direction cuts across the main structural units in the Iroise sea. As shown in fig. 1, if one extends the south Armorican shear zone to the West with the same curvature it would reach the edge of the continental shelf at  $47.5^{\circ}$ N,  $7.5^{\circ}$ W precisely where the character of the continental slope changes abruptly.

A new free-air gravity map compiled with data from the Centre Océanologique de Bretagne, Cambridge University [12, 13], Bedford Institute, the Royal Netherlands Navy [14] and the French Service Hydrographique et Océanographique de la Marine is

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Fig. 1. Simplified geological map of Brittany and adjacent continental shelf [7-10]. Depths in uncorrected fathoms [21]. Legend: 1, fault; 2, anticline; 3, syncline; 4, paleo valley; 5, Plio-Quaternary; 6, Neogene; 7, Middle Eocene; 8, Lower Eocene; 9, Upper Cretaceous; 10, Lower Cretaceous; 11, Siluro-Devonian; 12, amphibolites; 13, granites; 14, possible extension of the south-Armorican shear zone.

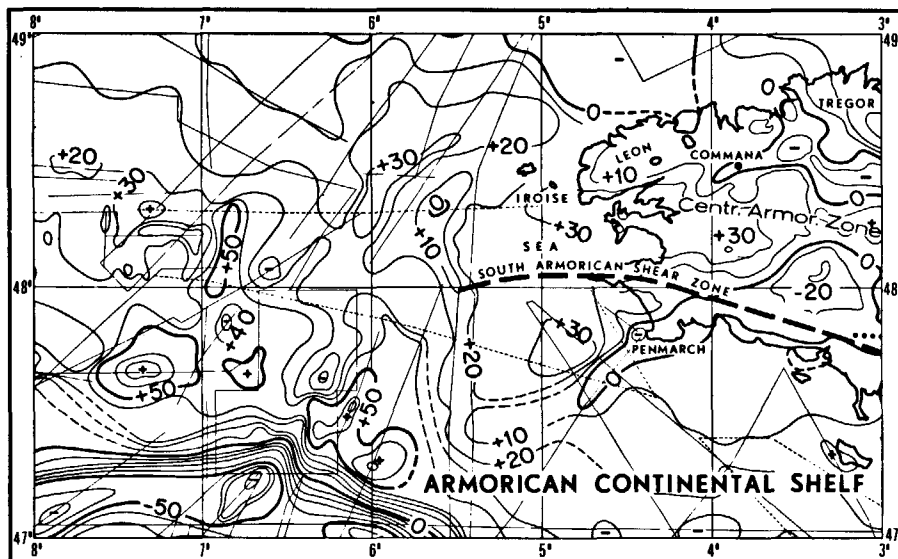


Fig. 2. Free-air gravity anomaly map of Brittany and adjacent continental shelf completed with Bouguer anomalies on land [15, 16]. Contour interval is 10 mgal. Dashed lines are tracks from Centre Océanologique de Bretagne and full lines are tracks provided by other laboratories (see text).

presented in fig. 2. The accuracy of the data is better than 10 mgal. On land, Bouguer anomalies have been used [15, 16]. The agreement between the two types of anomalies is good because the water layer is thin (less than 200 m), land relief low (200 m maximum) and the edge of the continental margin quite distant. Two main features can be recognized on this map. One is the Late Hercynian shear zone and the granitic intrusions associated with it, the other is the contrast in patterns north and south of this zone.

With few exceptions, granites of the Armorican massif are associated with negative anomalies [17, 18]. The two large negative bands of anomalies in Brittany correspond first to the metamorphic and granitic units of the Léon and to the granitic complex extending eastward from Comana and second to units such as the south Armorican shear zone and associated granitic intrusions. Extension towards the continental shelf of these granites is quite limited. Only the granitic massif of Penmarch could have dimensions similar to granitic intrusions located north of the shear zone (fig. 2). On either side of the belt of anomalies related to the shear zone and associated granitic units, one notes contrasting patterns of gravity anomalies. To the north, gravity anomalies outline the EW to ESE-WNW Paleozoic or earlier structures, as for example the EW

anomalies north of the Loire river or the ESE-WNW anomalies associated with the Lanvaux granitic lineament. To the south, the gravity anomaly pattern is featureless except perhaps a few EW anomalies of 20 mgal amplitude on the Armorican continental shelf.

This difference in pattern agrees with the idea that the south Armorican shear zone has acted as a shear fault; the horizontal motion along this Late Hercynian fault brought into contact two regions with differing geology. On this basis, the horizontal displacement has to be of the order of several hundred kilometers.

The south Armorican shear zone is quite extensive in Brittany but does not exist in Spain (fig. 3). It seems therefore to have separated the Hercynian belt of Spain from the portion of the Hercynian belt of Brittany located north of the shear zone. Fig. 3 shows the position of the Iberian peninsula before the opening of the Bay of Biscay. This position has been calculated from transform directions in the Bay and on adjacent land [19, 20]. In order to further reconstruct the original Ibero-Armorican belt, the displacement due to the south Armorican shear zone and perhaps to the north Pyrenean fault has to be removed. The proposed scheme for the role of the shear zone is shown in fig. 4.

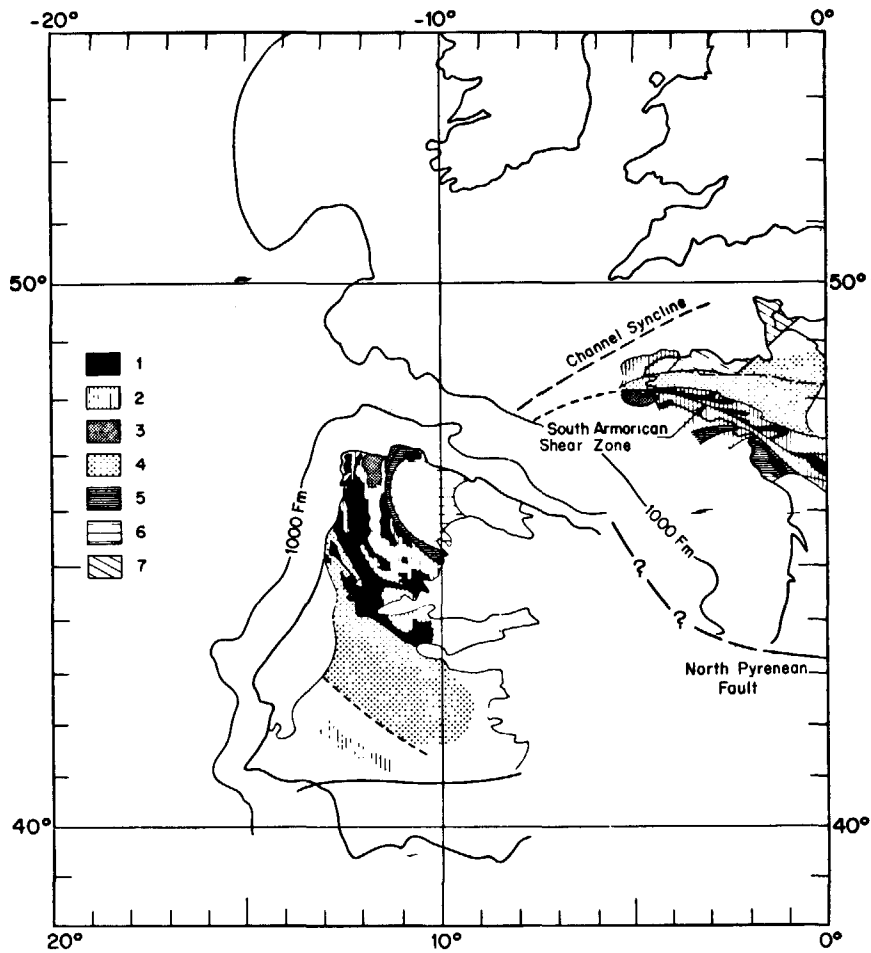


Fig. 3. The Iberian Peninsula has been rotated 23° clockwise about a pole at 50.0°N; 3.3°E [19, 20]. Stratigraphic Hercynian correlations between Iberian peninsula and Armorican massif are shown [2]. 1, Syntectonic leucogranites; 2, Orthogneisses and other metamorphic rocks of the axial zone; 3, Acid, basic and ultrabasic complexes of catazones; 4, Central Armorican zone and central Iberian zone; 5, Schists and porphyroids of Vendee and Cevennes correspond to 6, Olla do Sapo Series from Spain; 7, Pentevrian basement.

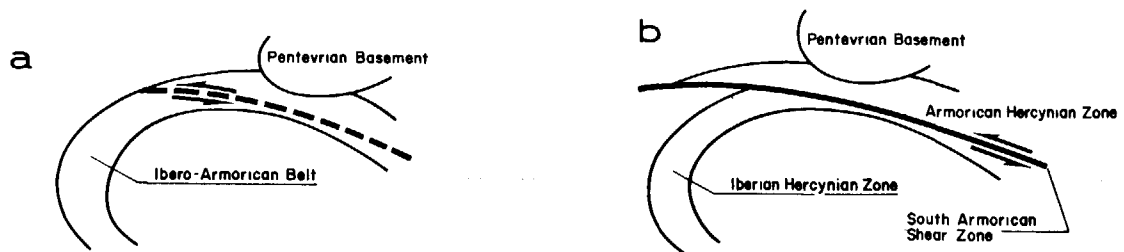


Fig. 4. Sketch of the Hercynian Ibero-Armorican belt before (a) and after (b) the movement along the south Armorican shear zone. For illustrative purposes the motion along the shear zone has been taken as left-lateral.

Any reconstruction of the original relative positions of continents before the opening of the Bay of Biscay based on continuity of the Ibero-Armorican belt will be uncertain as long as the direction and the amplitude of the horizontal movements of the south Armorican shear zone are not better established.

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