EXCURSION GUIDE FOR FIELD TRIP V3
ISLANS OF FAYAL AND PICO

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1. INTRODUCTION

The Azores are situated at the intersection of the mid-Atlantic ridge with the Azores-Gibraltar fracture belt which is part of the Alpine orogenic chain. At this triple junction converge the so-called American, Eurasian, and African plates.

On 6 of the islands there are 9 active volcanoes: the number of independent submarine vents is unknown, but 4 had recorded eruptions since the 15th century.

Seismicity of the islands is considerable, which certainly results from plate movement. According to one of the tectonic models proposed for the area, the mid-Atlantic rift could cross all the islands with active volcanoes (Fayal, Pico, San Jorge, Graciosa, Terceira and San Miguel). Expansion along the rift would be accompanied by shear at the associated transform faults, this shear being responsible for most of the frequent earthquake swarms.

The present tectonic situation is further complicated by the effect of the Alpine movements, which also seem to produce

crustal expansion to the west of a no-strain point at longitude 22° West.

Another tectonic model assumes simply that the mid-Atlantic rift is situated between Fayal and Flores, and is intersected by a minor rift and spreading centre (the Terceira rift) that merges into the Azores-Gibraltar fracture zone.

2. GEOLOGICAL SUMMARY

Fayal is a central volcano with a summit caldera. The older lavas are mostly basalts ; the lava flows produced gentle slopes where adventive eruptions formed small basaltic cinder cones ; exceptionally there are two trachyte domes.

In Recent times explosive trachytic activity produced important pumice fall deposits (and some pumice flows) ; this pumice covers now most of the island. Following the big explosions, the summit of the mountain collapsed, forming the caldera which is about 2 km wide and 500 m deep.

Very recently, basaltic activity has resumed and formed the lava fields and cinder cones of the west ridge, which are not covered by the pumice layers of the central explosions.

Pico volcano is a tall basaltic cone (2351 m high) which accumulated at the western end of a previous linear volcanic ridge. The new central vent formed first a shield volcano and then a big central cone whose steep slopes suggest that the corresponding material is mostly basaltic cinder. In many places, however, the cinder has been covered afterwards by basaltic flows from the main vent.

The western two thirds of the island form thus a conspicuous lava field of Recent age. There are many small cinder cones on the primitive lava shield, as well as along the eastern ridge.

Branches of the mid-Atlantic rift are supposed to exist at the west part of Fayal and at the central part of Pico. These two branches are connected by a transform fault (or fault system) which has exhibited considerable seismic activity. The remarkable grabens of the east slope of Fayal are probably associated with this complex fault. Another transform fault seems to run westwards along the south coast of Pico Island.

3. VOLCANIC ACTIVITY

Since the settlement of Fayal and Pico in the 15th century, the following eruptions have been recorded :

— 1562, effusive activity on the east ridge of Pico, with basaltic lava flows to the north coast.

— 1672, basaltic eruption on the west part of Fayal ; lava flows reached the north and south coast of the young lava field.

— 1718, basaltic eruptions on the north and south slopes of th main cone of Pico, with important lava flows, especially to the north coast.

— 1720, activity on the east ridge of Pico with basaltic lava flows to the south coast.

— 1957, basaltic eruption off the west end of Fayal (Capelinhos), starting as strong intermitent submarine explosions, and changing in 1958 to an effusive eruption with many short lava flows ; a spatter cone developed inside the cinder and ash ring of the previous explosions.

4. EXCURSION ROUTES

The excursions are planned as follows : —

Fayal Island (1st day)

1st stop: — Flamengos. Pumice and ash flows from the big explosive phase of Fayal volcano ; the material is being excavated for use in road works.

2nd stop: — Largo Jaime Melo. View on the graben of the actual active transform fault.

3rd stop: — Caldeira. Sumit caldera formed by subsidence, which followed the pumice eruptions of Fayal volcano ; during the 1958 effusive phase of Capelinhos eruption, a minor explosion and fumarolic activity were recorded at the bottom of the caldera.

4th stop: — Cedros. Pumice deposits produced by the central vent Plinian explosions and Péléan type pumice flows of Fayal volcano.

5th stop: — Ribeirinha. Oldest lavas of Fayal (probably Pleistocene).

6th stop: — Espalamaca. Actual active transform fault separating the African and American plates ; grabens associated with the fault system ; view of San Jorge and Pico (including the disrupted Madalena rocks).

Pico Island (2nd day)

7th stop: — Santa Luzia. Lava flows of the 1718 eruption and sea erosion on young flows.

8th stop: — Santo António. Olivine basalt flows with large phenocrysts ; scarps of the eastern volcanic ridge.

9th stop: — Lages. Limit of branch of the mid-Atlantic rift ; lavas of Pleistocene age.

10th stop: — Mato da Silveida. Lavas of the 1720 eruption and transition to older lavas.

11th stop: — Bocas de Fogo : Empty vents (funnels) of the 1718 eruption ; close view of the steep central cone.

12th stop: — Frei Matias Caves. Interior of pahoehoe lava flow with basaltic stalactites.

13th stop: — Madalena. Active transform fault ; islets corresponding to previous palagonite ring cut by the sliding of the fault.

Fayal Island (3rd day)

14th stop: — Castelo Branco. Trachyte dome ; pumice fall deposits of the Plinian eruptions of Fayal volcano.

15th stop: — Arieiro. Lava flows of the 1672 eruption ; fissure marked by line of cinder cones along the western ridge.

16th stop: — Capelinhos. Spatter cone inside cinder and ash ring, both formed during the 1957-58 eruption ; palagonite tuffs in old cliff line.

17th stop: — Fajã. Recent lavas with olivine nodules ; possible scarp of mid-Atlantic rift.

18th stop: — Praia do Norte. Fractures of the strong earthquakes of 1958; houses rebuilt after the seismic catastrophe.

19th stop: — Varadouro. Thermal springs ; lava of the 1672 eruption and cliff cut on the main cone.

20th stop: — Lomba. Flamengos valley with young cinder cones ; graben of active transform fault.

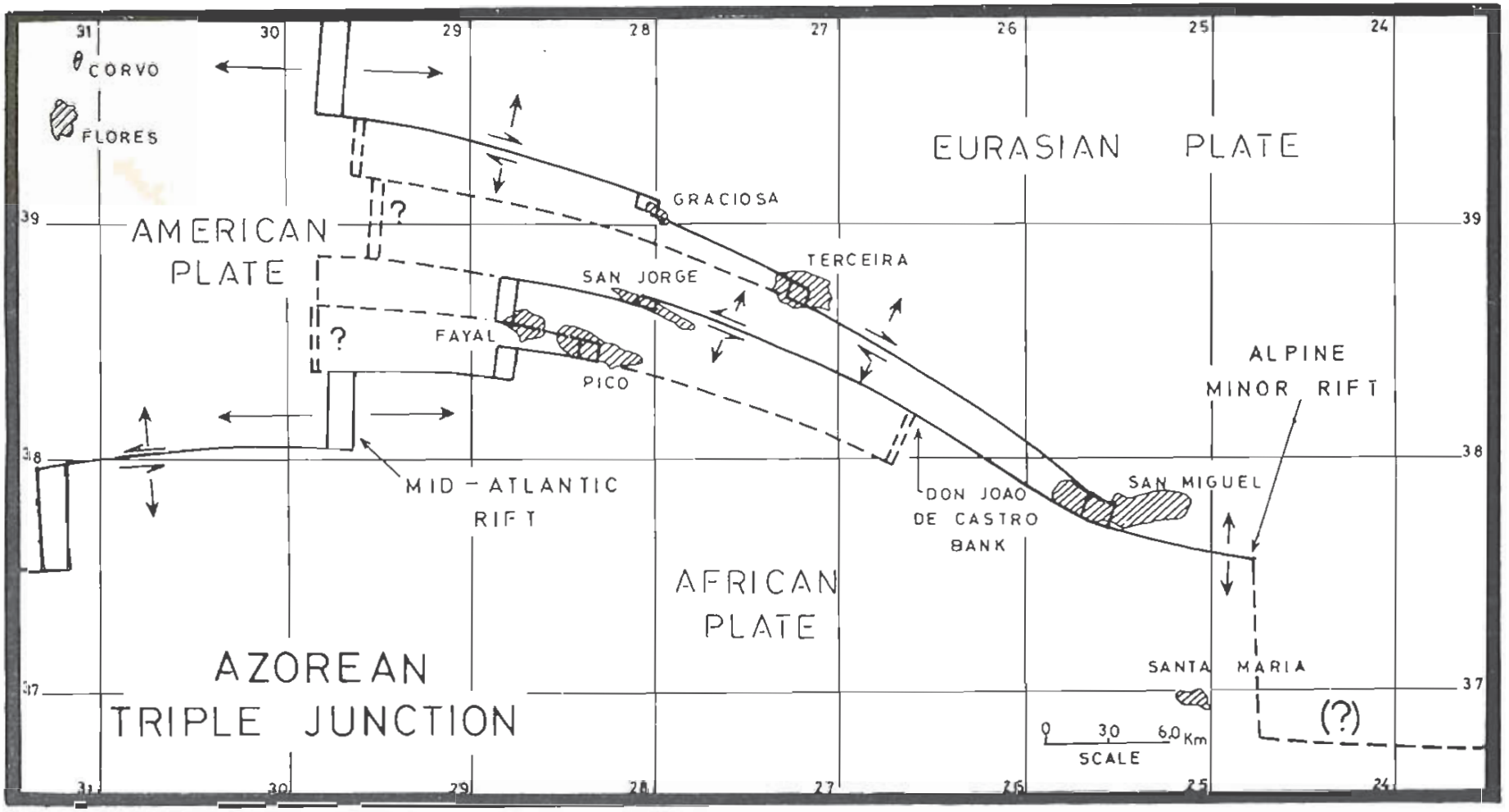
21st stop: — Monte da Guia. Palagonite tuff cone with double crater ; south slope of main volcano.

Fayal sea trip (4th day)

22nd stop: — Monte da Guia. Double crater of palagonite tuff cone.

23rd stop: — Porto Pim. Young lava flows and sand isthmus of Monte da Guia (used as a beach).

24th stop: — Feteira. Sea caves made by wave erosion under young lava flows.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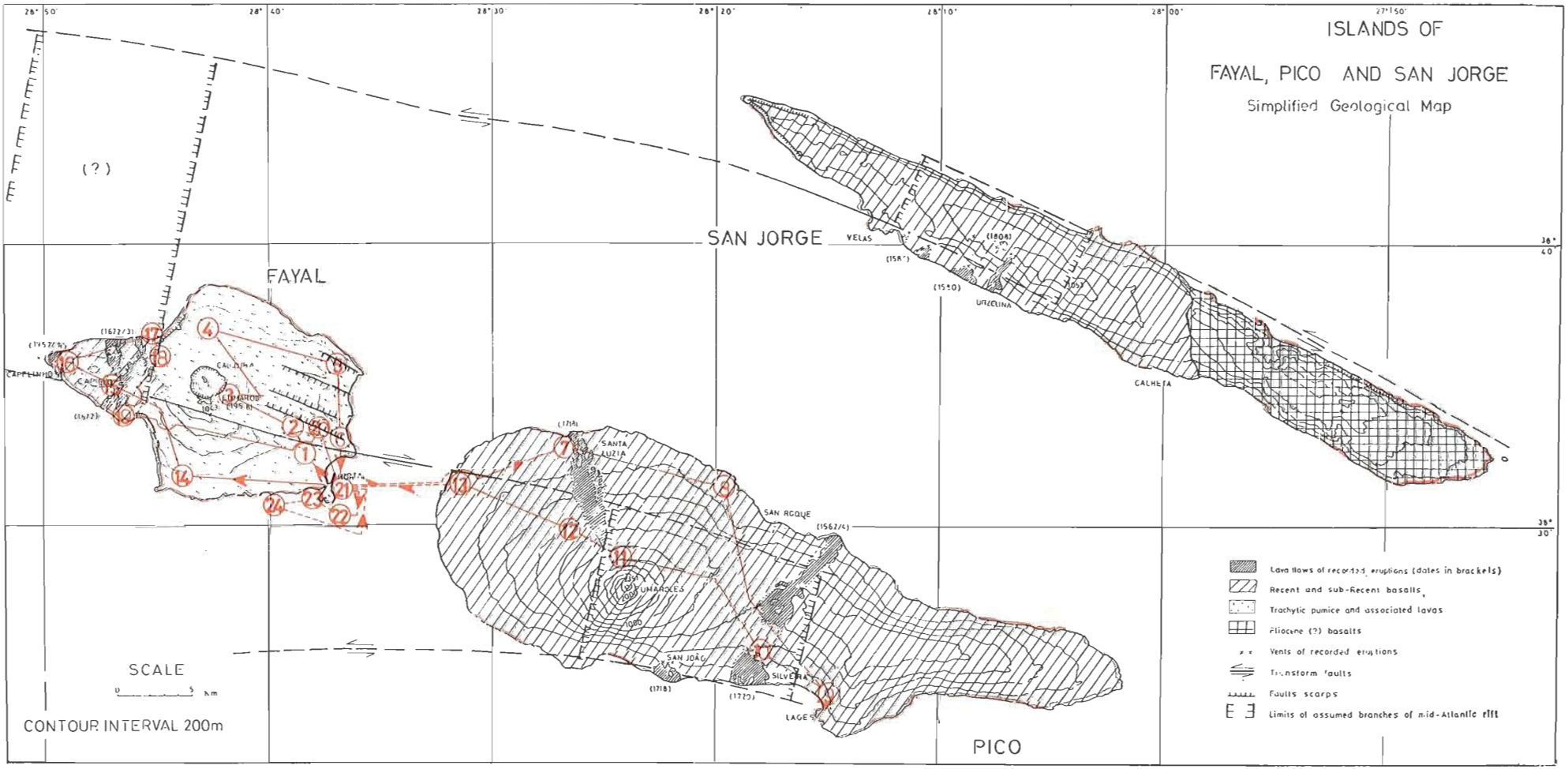
CORVO
FLORES
EURASIAN PLATE
AMERICAN PLATE
GRACIOSA
TERCEIRA
SAN JORGE
FAYAL
PICO
ALPINE MINOR RIFT
MID - ATLANTIC RIFT
DON JOAO DE CASTRO BANK
SAN MIGUEL
AFRICAN PLATE
AZOREAN TRIPLE JUNCTION
SANTA MARIA
(?)
0 3.0 6.0 Km
SCALE


ISLANDS OF
FAYAL, PICO AND SAN JORGE
Simplified Geological Map
28° 50'
28° 40'
28° 30'
28° 20'
28° 10'
28° 00'
27° 50'
38° 40'
38° 30'
(?)
SAN JORGE
FAYAL
PICO
VELAS
(1580)
(1808)
(1580)
URZELINA
CALHETA
SANTA LUZIA
SAN ROQUE
(1562/4)
(1718)
UNHARES
SAN JOÃO
(1718)
SILVEIRA
(1720)
LAGES
CAPELINHOS
(1672/3)
(1672)
CALDEIRA
(1957/8)
SCALE
0 5 km
CONTOUR INTERVAL 200m
Lava flows of recorded eruptions (dates in brackets)
Recent and sub-Recent basalts
Trachytic pumice and associated lavas
Pliocene (?) basalts
Vents of recorded eruptions
Transform faults
Faults scarps
Limits of assumed branches of mid-Atlantic rift

5. SELECTED LITERATURE

1929 — FRIEDLAENDER, I. : *Die Azoren*. Z. f. Vulkanologie, B. 12, p. 77-107.

1936 — AGOSTINHO, J. : *The volcanoes of the Azores*. Bull. Volcanol., t. 8, p. 123-138.

1958 — TAZIEFF, H. : *L'éruption 1957-1958 et la tectonique de Faial (Açores)*. Bull. Soc. Belge Géol. Paléont. et Hydrol., t. 67, p. 13-49.

1959 — *Le Volcanisme de l'Ile de Faial et l'éruption du volcan de Capelinhos* (symposium), Mem. 4 (n. sér.). Serv. Geol. Portugal.

1960 — ZBYSZEWSKI, G. : *L'éruption du vulcan de Capelinhos (Ile de Faial, Açores)*. Bull. Volcanol., t. 23, p. 77-100.

1962 — MACHADO, F., PARSONS, W. H., RICHARDS, A. J. and MULFORD, J. W. : *Capelinhos eruption of Fayal volcano, Azores, 1957-1958*. J. Geophys Res., v. 67, p. 3519-3529.

1962 — ZBYSZEWSKI,, G., FERREIRA, C. R. and FERREIRA, O. da V. : *Etude géologique de l'île de Pico (Açores)*. Com. Serv. Geol. Port., t. 45, p. 5-34.

1970 — KRAUSE, D. C. and WATKINS, N. D. : *North Atlantic crustal genesis in the vicinity of the Azores*. Geophys. J., V. 19, p. 261-283.

1972 — MACHADO, F., QUINTINO, J. and MONTEIRO, J. H. : *Geology of the Azores and the mid-Atlantic rift*. Proc. 24th Int. Geol. Congr. (Montreal), Section 3, p. 134-142.