

Volcanoclastic Basaltic Deposits Between 400 and 2000 m.b.s.l. at the Axis of the Mid-Atlantic Ridge South of the Azores

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Subaqueous volcanic activity along mid-oceanic spreading centers is essentially effusive. However, intermediate-depth to deep-sea basaltic pyroclastic deposits have been described in a few locations. But little is known about the exact fragmentation process(es) and the limitation factors involved in the genesis of these deposits.

An extensive set of samples was collected during two marine geological surveys along three progressively deeper accretion segments of the Mid-Atlantic Ridge ; the segments 38 20'N, Menez Gwen and Lucky Strike (Fouquet et al., 1998; Ondr as et al., 1998). Located south of the Azores, they are respectively centered around latitude 38 20'N, 37 52'N and 37 18'N, and show a respective waterdepth range for the deposits of 400-930, 700-1150 and 1600-2000 m.b.s.l. These marine geological surveys, initially devoted to the study of hydrothermal activity, allowed using a deep-sea submersible to map the extension of the volcanoclastic deposits, to sample them in-situ as well as the surrounding formations and to collect morpho-structural informations about their relationships with the basement.

Each individual segment presents a central morphologic high where the magmatic and hydrothermal activities are concentrated, as well as the emplacement of the volcanoclastic deposits. The thickness and the extension of these deposits decreases with waterdepth along the three successive segments. But the observation of sedimentary beds and the frequent intercalation of marine biotrititic sediments shows that they were emplaced during long-lasting episodes of similar volcanic dynamisms.

The proximity of the Azores hot-spot explains the enrichment in incompatible elements and volatiles (H₂O, S, Cl and presumably CO₂) relative to N-MORBs. The morphology of the segments (deeper near its tips and shallower in its center) increases also the concentration of volatiles below the center of the segments. This fact and the presence of extensive hydrothermal systems, favorise magma-water interactions and therefore the emplacement of the erupted basaltic magma through explosive dynamisms.

the explosivity of the basalts emplaced there.

The lithology of the collected samples go from fine hyaloclastitic ashes to coarse grained hyaloclastitic lapilli, containing lithic fragments from the basement (interiors of pillow lava, non vesicular glass fragments, etc) and variable amounts of carbonates. The vesicularity of juvenile magma clases varies from scoriaceous to basaltic pumices with more then 60 % of vesicules. The granulometric study of the deposits suggests that they were emplaced mainly as fallouts or as a few basal surges close to the events. The SEM morphological study of the clasts gives informations of the fragmentation processes :

- Magmatic fragmentation by volatiles exsolution results of a high initial content in volatiles and of the subsurface interaction with hydrothermal fluids ;

- Fragmentation by total magma-water interaction is a important fragmentation process in response to interactions of the rising magma with the hydrothermal system as well as by the incorporation of basement fragments and volcanoclastitic fragments saturated in water at the level of the event ;

- Fragmentation by surface magma-water interaction only applies high above the event and during the emplacement of the very few basal surges observed as deposits around the events ;

- Thermic contraction fragmentation, favorised by high extrusion rates, is an accessory process that might take place in the upper part of the eruptive column.

The results obtained on this samples set demonstrate that, in response to concurrent favorable morphostructural and geochemical factors, magma-water interactions are able to produce basaltic explosive eruptions down to water depth much deeper that what was commonly admitted until today.

Fouquet Y., Eissen J.P., Ondr as H., Barriga F., Batiza R. & Danyushevsky L., 1998 - Extensive volcanoclastic deposits at the Mid-Atlantic Ridge axis : results of deep-water basaltic explosive volcanic activity ? *Terra Nova*, 10, 5: 280-286. Ondr as H., Fouquet Y., Voisset M. & Radford-Knoery J. 1997 - Detailed study of three contiguous segments of the Mid-Atlantic Ridge, south of the Azores (37 N to 38 30'N), using acoustic imaging coupled with submersible observations. *Marine Geophysical Research*, 19:231-255.