

## B12

## PHREATOMAGMATIC ACTIVITY IN THE VOLCANISM OF THE FRENCH MASSIF CENTRAL

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Phreatomagmatism is an essential feature in the tertiary and quaternary volcanism of central and south-eastern France: (i) the oldest volcano (Menat group, 60 M.y.) and the youngest (lac Pavin, 3450 B.P.) are maar-type vents; (ii) the northernmost (Menat group) and the southernmost (Agde volcano) are also maar-type vents; (iii) maars belong to the basic magma-type as well as the intermediate or differentiated magma type. Phreatomagmatic structures prevail (or are exclusive) in paleolacustrine surroundings: Bassin du Puy and Cantal, and in sedimentary areas: Limagne, Colrons, Causses, Lodevois, Escandorgue. They are common in the plateau-basalts fields where underground water is abundant (Devès, Cézailier, Aubrac), and in the strato-volcanoes (Cantal). They are less frequent (about 10% of the vents) in the areas characterised by volcanoes scattered on a granitic basement (Chaîne des Puys). In the Livradois country it has been pointed out that the presence of a sedimentary layer (at the time of eruption, but now eroded) at the surface of the granitic basement explains the frequency of the phreatomagmatic volcanoes.

All the characteristic features of interest concerning phreatomagmatism can be observed, except the deep roots of the volcanoes: -The phreatomagmatic structures are maars, or tuff-rings, and their underlying diatremes; the present morphology depends on the hardness of the wall rocks, the age of the volcano, the presence (or the lack) of a cap of hard rocks (cooled lava lake or various sediments) in the paleocrater. The level of erosion is never very deep, usually less than several tens of metres, though exceptionally a hundred metres or more. In exceptional cases it is possible to observe in a single volcano (Langeac, H.L.; Rochessaive, Colrons) a crater with associated deposits and the upper part of the underlying diatreme.

-Many outcrops are favourable to the study of eruptive mechanisms (base surge, flow or fall deposits) and subsequent phenomena in the pipe (fluidization, collapse).

-Various types of infilling of the crater are also interesting; this can be volcanic, both autochthonous (strombolian cone, pillow lavas, lava lake, dome or protrusion), and allochthonous (lava or pumice flow) or sedimentary: limestones, chemical clays or silica, such as diatomite, resinite or millstone deposits.

-The sedimentary filling of a maar crater is always fossil-rich, with pollens, leaves, fishes, etc. It has been pointed out that the vertebrate beds found in the volcanic areas of the French Massif Central are generally in maars or tuff-ring craters.

-The example of the Chaîne des Puys shows that differentiated magmas are strongly affected by even a minimal water supply; basaltic magmas need larger quantities of water to modify their activity.

Our works have pointed out:

-(i) that sub-aquatic (sub-marine, sub-lacustrine or sub-glacial) activity "surtseyan type" is very different from subaerial activity "phreatomagmatic s.s. activity";

-(ii) that the magma type is an important factor in the power supply, conditioning subaerial activity: as a general rule maars result from basaltic magmas (sometimes from differentiated magmas) and tuff-rings from differentiated magmas;

-(iii) that the substratum is also important, from the point of view of its structure (which affects the water supply), its texture (which affects the dust supply, which will condition fluidization), and its superficial morphology (which conditions the path of the base surge or flows).

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## HYALOCLASTITES DANS LES LACS VILAFRANCHIENS DU VELAY (France)

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Les fossés d'effondrement villafranchiens du Velay ont été le siège d'une sédimentation lacustre avec laquelle interfèrent des structures hyaloclastiques de nature basanitique. La montée de ces magmas est liée aux distensions responsables de la subsidence.

Les structures observées dans le Velay (Bassins du Puy et de Langeac en particulier) varient selon les niveaux d'érosion : écoulements pyroclastiques et anneaux de tufs (formes tabulaires), diatèmes à tufs lités centroclinaux (buttes et collines), pipes bréchiques armés de dykes (rochers et aiguilles). Des phénomènes de subsidence intracraticère ont pu être observés (panneaux de substratum ou de l'anneau de tufs basculés). Ces formations bréchiques, litées ou non, se présentent sous la forme de granules vitreux emballés dans un ciment cendreuse indurée.

L'observation d'éruptions récentes en milieu aquatique (Capelinhos aux Açores, Surtsey en Islande) a permis l'étude de dépôts de hyaloclastites et leur évolution ultérieure. Au Capelinhos en particulier, la consolidation des niveaux cendreuse par palagonitisation a pu s'effectuer pendant l'éruption et transformer sur place la base immergée de l'anneau de tufs. L'influence de l'eau disparaissant, l'activité évolue vers un modèle plus banal, strombolien ou (et) effusif dont les produits comblent alors l'ancien cratère de l'anneau de tufs.

La convergence des formes, structures et produits de ces appareils marins avec ceux du Velay est remarquable, impliquant nécessairement des conditions génétiques voisines, donc des éruptions en eau libre (lacs villafranchiens) pour les appareils bréchiques vellaves. Ces derniers ont en outre l'avantage, compte tenu de leur niveau d'érosion, de permettre l'accès aux substructures indispensables à la compréhension des mécanismes éruptifs.