Geophysical Research Abstracts
Vol. 13, EGU2011-426-1, 2011
EGU General Assembly 2011

Emplacement of large volcanoclastic breccia volumes in relationship with the evolution of a central caldera: volcanic history of the Cantal massif (France)

Sébastien Leibrandt, Pierre-Yves Gillot, and Anthony Hildenbrand
Laboratoire IDES, Université Paris Sud, France (sebastien.leibrandt@u-psud.fr)

The Cantal strato-volcano is the largest eruptive complex of the French Cenozoic volcanic province. It has been active during the Upper Miocene and has been characterized by the emplacement of voluminous volcanoclastic breccias, which the origin and the significance remain controversial. Field observations, coupled with new K-Ar ages, allow us to reconstruct the morpho-structural evolution of the massif and to examine the relationships between the development of a central volcano-tectonic collapse and the generation of the main breccias. We show that the growth and partial destruction of the volcano is recorded by a unique stratigraphic sequence preserved at the periphery of the massif but interrupted in its central part. Four main stages of evolution are distinguished: (1) The activity of an initial trachyandesitic complex is constrained between 9.31 $\pm$ 0.13 and 8.07 $\pm$ 0.11 Ma: the alternance of surges, dome collapse monogenic breccias and lahars constitute the flanks of this dome pileup complex. This one rests on the Hercynian fractured basement overlying by a dispersed fissural basaltic activity; (2) The partial draining of a magmatic reservoir during moderate plinian episodes, supported by the presence of pumice levels, coupled with a basement tectonic instability gave progressively birth to a central caldera. During a period of inactivity, this 8 x 10 km elliptic volcano-tectonic depression was filled up to form a lake. Then, the volcanic activity resumed by a new plinian-like event: a pumiced juvenile magma loaded in fluids interacts with the lake. Mixing between pulverized magma and water initiated a viscous breccia, which overflowed the caldera rim and propagated radially reaching more than 25 km from the centre. This process is typical of intracaldera lake eruptions involving juvenile material. Its facies and its stratigraphic position are identical all around the massif. It is composed of heterometric and heterogenic clasts trapped in a welded pumice and clay cement. The deposit architecture, the high cohesion evidences of the matrix, the distribution of the clasts and the absence of significant interactions between them, support characteristics of a giant cohesive debris flow with a volume of up to 100 km3. We constraint this unique event between 8.07 $\pm$ 0.11 and 7,80 $\pm$ 0.11 Ma; (3) Then, the extrusion and destruction of domes within the caldera produced pyroclastic laminated deposits, associated with reworked events, filling the caldera in a short time and partially overflowing on the external slopes of the strato-volcano; (4) Finally, during a basaltic activity along the caldera borders, fluid lavas extended largely all around the external slopes. The vents are distributed along a similar elevation all around the caldera rim. These lava flows fossilize the regular morphological shape of the massif resulting from the emplacement of the preceding giant debris flow. The basaltic emission vents coincide with the source of the giant debris flow: it delimitates the caldera rim. Thus, this large volcano-tectonic structure, directly linked with regional tectonic directions, has had a major influence on the evolution of the massif including the generation of a giant debris flow.