PETROGENETIC STUDY OF LAVAS ERUPTED THROUGH THE PERSISTANT EXPLOSIVE ACTIVITY OF THE NEVADO SABANCAYA VOLCANO, PERU (1990-1998)

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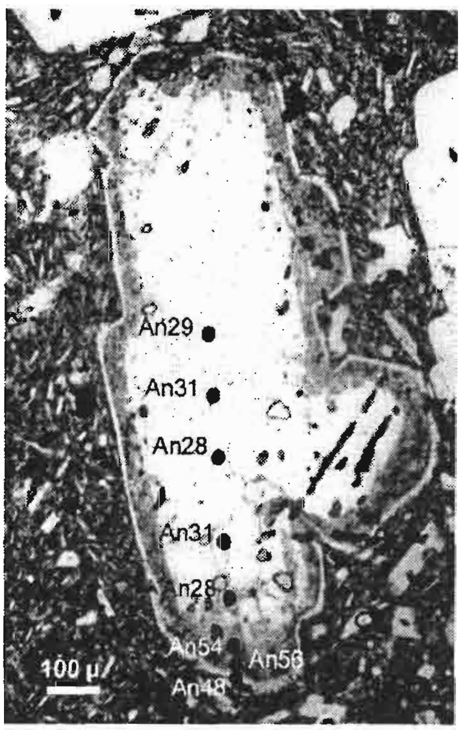
INTRODUCTION :

Located within the Western Peruvian Cordillera (16°13'S, 71°51'W) in the Central Volcanic Zone, the Nevado Sabancaya volcano belongs to the group of active volcanoes of Southern Peru. Its Holocene activity is dominated by lava flows and lava domes, with few occurrences of pyroclastic deposits : one tephra layer was trapped in a proximal peat-bog attesting of a previous explosive activity about 8500 years ago (Juvigné et al., 1998). It presents a persistant explosive activity since the eruption of May 28, 1990, generating only air-fall tephra. The behaviour was increasingly explosive during the two first years, and was rather constant until late 1994, with hydromagmatic and moderate-magnitude vulcanian activity (Thouret et al., 1994). Since 1995, the frequency of explosions decreased gradually so that the time intervals between two events increased from 30 minutes to several hours. Since late 1997, the activity has been mainly phreatic (Bulmer et al;, 1997). The emission rate has decreased since 1994, with an overall increase of the juvenile component proportion through the eruption.

The erupted juvenile products consist of dark glassy, poorly vesiculated and highly porphyritic lavas of andesitic to dacitic compositions. They are characterized by high alkali-contents, and plot in the field of the high-K calc-alkaline series. The silica-content evolution is not linear through time : the 1990 lavas are the most evolved (61 to 64 wt% SiO_2), then the composition drop down to 60-61.5 wt% SiO_2, and from 1994, it remains rather constant (61.5-62.5 wt% SiO_2). The juvenile facies emitted since 1992 eruptions contain rare nearly aphyric enclaves. These small enclaves range from 1 to 10 cm in size and exhibit a sharp boundary and some radial fractures. They are poorly vesiculated and exhibit microdoleritic textures. Their texture attests of their crystallization in the plumbing system. They are plagioclase- and amphibole-rich. They are characterized by lower silica-content (about 57 wt% SiO_2).

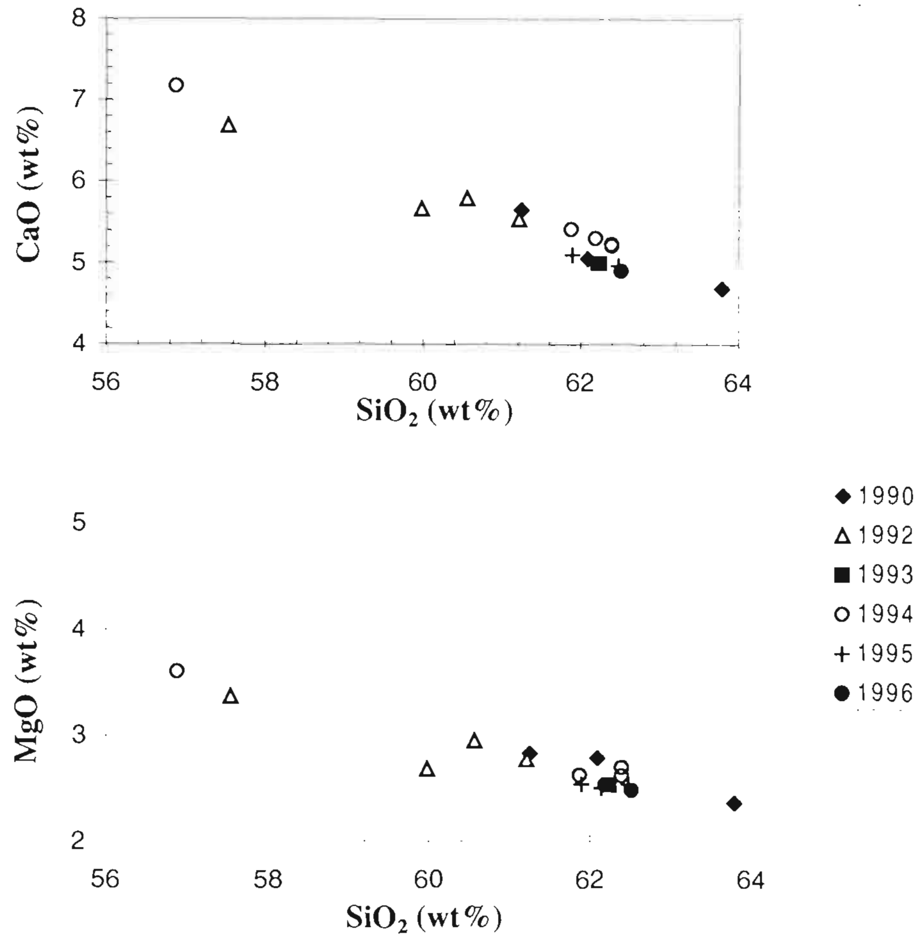
Lavas contain two types of plagioclase phenocrysts. Type A phenocrysts are optically unzoned, and have homogeneous oligoclase-andesine composition (An28-40). Type B phenocrysts are characterized by large homogeneous oligoclase-andesine cores coated with an inclusion-rich labradorite mantle (An 45-65) and a clear labradorite outer rim of a few micrometers. Microdoleritic enclaves contain optically unzoned homogeneous labradorite plagioclase (An45-60).



Type B plagioclase phenocrysts

Type B phenocrysts reverse compositional zoning may account for magma mixing processes. A dacitic magma in equilibrium with andesine plagioclase compositions has been mixed with inputs of an andesitic magma batch in equilibrium with labradorite plagioclase composition. All 1990-98 lavas contain both types of phenocrysts, but the first emitted dacitic lavas (about 64 wt% SiO_2) contain almost only type A plagioclase, suggesting that it might represent the dacitic component. Microdoleritic enclaves might represent fragments of the andesitic component crystallized in the plumbing system. These hypovolcanic rocks were carried up by magmas erupted during the actual eruption . Thus these enclaves do not give any evidence of a new magma injection prior to eruption that may have triggered off the actual volcanic crisis.

The overall series displays major and trace element trends and REE patterns, that might account for both fractional crystallization and magma mixing imprints: (i) The early emitted dacitic magmas might be derived from an andesitic magma batch similar in composition to the microdoleritic enclaves, by the fractionation of plagioclase, amphibole, iron-titanium oxides and clinopyroxene; (ii) The intermediate lavas (60.5 to 62.5 wt% SiO_2), which exhibit mineralogical evidences of magma mixing might be issued from the mixing in variable proportion of the dacitic magma with an andesitic component.



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