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Geology and structure of the late Pleistocene to Holocene Chimborazo stratovolcano (Ecuador)

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INTRODUCTION

In Ecuador, volcanoes of the Northern Volcanic Zone of the Andes are distributed along three subparallel alignments: the frontal arc in the Western Cordillera; the main arc in the Cordillera Real and the back-arc region in the upper Amazonia. At 150 km south-southwest of Quito, Chimborazo is the highest ice-capped volcano in Ecuador and also in the Northern Volcanic Zone (6268 m). It lies upon the Western Cordillera basement, consisting of sediments and volcanics of Cretaceous to Palaeogene age (McCourt et al., 1997). A few works were already concerned with its geology (Kilian, 1987; Clapperton, 1990; Beate & Hall, 1989). However, no consensus exists concerning the overall structure and evolution of this large volcano. Glacial retreat during the last decades favoured new field observations, which were complemented with a geochemical and mineralogical study. In this communication, we present a preliminary model of the volcano's structure and evolution, constrained by these new data as well as $^{40}Ar/^{39}Ar$ datings.

THREE MAIN PHASES OF DEVELOPMENT

Chimborazo is a large composite strato-volcano, with three main summits in a WNW-ESE direction, defining a variable height relative to its base, from 2200 m to 3000 m. The western, highest summit, culminates at 6268 m (Schoterer et al., 2003). Most distal deposits spread out on the Riobamba plain to an altitude as lower as 2600 m in the Chambo river (~33 km from the volcano). The orientation and convergence of lava flows and their chemical compositions indicate the construction of three successive volcanic edifices (Fig. 1).

Chimborazo I

The basal volcano (CH-I) is a massive, mainly effusive, strato-volcano whose relics are represented by radially-distributed, thick andesitic and dacitic lava flows (56.8 – 64.1 wt% SiO_2) interbedded with a few subglacial breccias. On the southwestern flank, the basal lava flows are overlain by a succession of andesitic (60.0 – 61.8 wt% SiO_2) block-and-ash flow deposits, indicating at least one period of dome growth and explosive activity during the edification. CH-I lavas bear plagioclase, orthopyroxene, clinopyroxene, amphibole and magnetite. Two $^{40}Ar/^{39}Ar$ whole-rock datings yield surprisingly young "plateau" ages of 93±5 and 83±7 ka, revealing a late Pleistocene age for this basal edifice. Scarce outcrops of a valley-ponded ignimbrite deposit were found on the northern flank of the complex, particularly in the Río Ambato valley, where it is 35 m thick at 16.5 km away from the vent. This ignimbrite consists of non-welded, biotite and sanidine-bearing rhyolitic pumice (70.0 wt% SiO_2). This unit indicates that the older edifice ended with a major caldera-forming eruption. Indeed, on the western flank, a caldera rim is well preserved (Fig. 1).

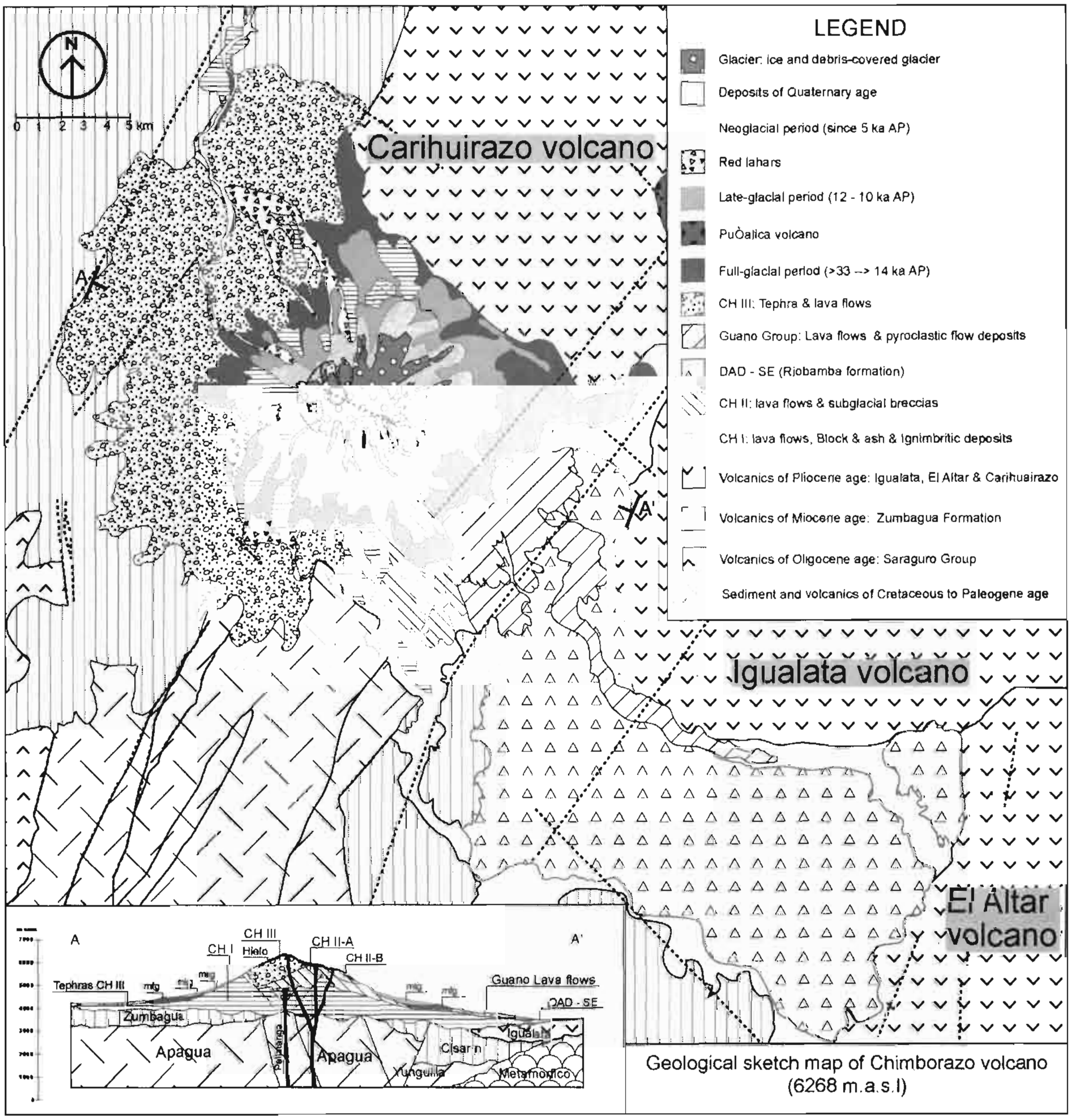

Figure 1. Simplified geologic map of Chimborazo volcano.

Chimborazo II