



## **Characterization of the 3 km<sup>3</sup> Cubilche Debris Avalanche Deposit, Imbabura Volcanic Complex, Northern Ecuador.**

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Debris avalanche deposits (DAD) are common products of catastrophic volcanic edifice collapses. The city of Ibarra, located in northern Ecuador, is surrounded by at least seven volcanoes that collapsed during the Quaternary and lies directly on top of a large DAD. Cubilche volcano (3826 masl), located immediately S of the city of Ibarra (Imbabura Province) and E of the dormant Imbabura volcano, displays a horseshoe-shape scar towards the N. The knowledge of Cubilche is critical, because of its close proximity with Imbabura volcano. In fact, Imbabura edifice was built over the northwestern slope of the Cubilche volcano and subsequently partially covered it. The DAD presented here (named Cubilche-DAD), has never been described in detail and its source has not been conclusively determined. This deposit was recently linked to Imbabura volcano as a product of its northwestern sector collapse (LePennec et al., 2011); however, a previous work proposed that the DAD, covering  $\sim 80$  km<sup>2</sup> and reaching  $>13$  km with an estimated volume of 1.6 km<sup>3</sup>, was the product of the Cubilche volcano (Ruiz, 2003). The present work constrains the source of the Cubilche DAD through detailed fieldwork, petrological and geochemical analyses, and a detailed granulometric characterization. Additionally, a high-resolution DEM of the present day topography of Cubilche volcano shows that the morphology of the volcano is well-preserved on its southern, eastern, and western flanks. We reconstructed pre-collapse Cubilche through interpolation of elevation and altitude data. The reconstructed topography shows that it could have been a symmetric cone, reaching a maximum elevation of 4300 m.asl with a missing volume of 3.5 km<sup>3</sup>. Based on this scenario, the DAD originated from the Cubilche volcano collapse presents a volume much larger than the volume proposed by previous authors, and it seems to be in accordance with the volume calculated from our studies in the field.