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Diapiric structures in welded ignimbrite

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Diapiric structures (DS) are uncommon in welded ignimbrite and they are generated by an unstable gravitational density stratification (Rayleigh-Taylor instability) which forced the intrusion and the buoyant rise of lower lighter material into a denser upper cover. The time scale of the cooling process below the glass transition temperature represents the upper limit for the duration of the process of plastic deformation. The knowledge of the density contrast between the DS and the host rocks, together with the deformation style and the knowledge of the cooling time scale, through numerical models, allow to constrain the rheological behavior of the system.
The Serra di Paringianu rhyolitic ignimbrite (SEP) crops out on San Pietro and Sant'Antioco islands, while scattered outcrops are present in the Sulcis mainland (SW Sardinia – Italy). SEP is constituted by a single cooling unit, subdivided into four eruptive units (named U1, U2, U3 and U4) characterized by strongly variation in bulk rock densities. In the northern sector of San Pietro Island, tens meters-sized mushroom-shaped diapiric structures (DS) have been observed within SEP. DS are generally connected with their source region and their roots, characterized by vertical re-orientation of flattened purple scoriae, are placed about 8-10 m below the roof, within the U2. In plane-view, stem region is generally elongated and characterized by sub-vertical dip of foliation planes while cup region presents shape varying from circular to elliptical. Within the cup, foliation shows an approximately concentrical distribution, with dip increasing from the margins trough the center.
In order to simulate the ascent of the DS in a reliable conditions and to estimate the cooling and compaction history of SEP, we performed several numerical simulations with the AshPac software [Riehle et al., 1995].We estimated the viscosity of the melt through the model of Giordano et al. [2008]. The ascent velocity of a diapir with a Newtonian rheology ascending through a rock having Newtonian rheology can be calculated using the Stokes equation [Burov et al., 2003]. The model of development of DS can be schematized in three steps: a first phase where U2 heating up above Tg, followed by a second phase where the plume ascent is triggered by the formation of a Rayleigh-Taylor instability and a final phase during which the plume rose up.