



Magma storage, eruptive activity and flank instability: inferences from ground deformation and gravity changes during the 1993-2000 recharging of Mt. Etna volcano

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A long recharging period characterized Mount Etna volcano during 1993-2000 before the main explosive-effusive 2001 and 2002-03 flank eruptions. The joint analysis of ground deformation and gravity data over the recharge period reveals that different phenomena occurred within Etna's plumbing system and clearly indicates two phases spanning 1993-1997 and 1997-2000, respectively. The first phase was characterized by magma storage and accumulation at an intermediate depth (2-6 km below sea level), which provoked an overall inflation and positive gravity changes. During the second phase, the magma started to rise and intrude at shallower levels favoring the movement of the unstable eastern flank, which accelerated its sliding toward the East. The shallower magma accumulation also caused the gas exolution, associated with increasing explosive activity at the summit craters. Negative gravity changes were detected during this phase. The gravity measurements, independently of the same result obtained by geochemical studies, suggest that only 20-30% of the magma volumes supplied in the plumbing system were then erupted. The complex dynamic of rising magma beneath Mount Etna makes ground deformation and gravity measurements complementary, being able to detect different effects of magma emplacements beneath the surface. Our results also highlight how the joint use of ground deformation and gravity observations may be crucial in identifying the nature and rate of an impending period of volcanic eruptions.