We present new results on the sub-structure of the Somma-Vesuvius volcano, obtained by several seismological data, also consistent with geochemical evidences. Shallow structure (0-10 km of depth) has been determined by joint inversion of P- and S-wave arrival times from earthquakes and shots, and further constrained by geochemical data indicating crystallisation depths. The resulting picture shows an axial high rigidity core, going from about 0 to 4-5 km depth, with two main horizontal layers, one at depth of 2.5-3 km below the crater area indicating the limestone horizon, the other one at about 4-5 km, possibly indicating the top of a typical depth of shallow magma storage. The high rigidity anomaly is likely to be formed by solidified magma in the shallow conduits. On the basis of a finite differences thermal model, we demonstrate that simple conductive cooling cannot be responsible for the formation of the anomaly, because times would be too large, and the most likely mechanism involves solidification by H2O degassing. The occurrence of local earthquakes appears strongly affected by the main rigidity contrasts, as demonstrated by finite element stress field modelling. Earthquakes are clustered around the main rigidity contrasts, in agreement with the focusing of stress at such places inferred theoretically. Seismic moment distribution as a function of depth put in evidence two main peaks, which are in agreement with the two main horizontal discontinuities evidenced. The intermediate (10-15 km) and deeper structure, determined by reflected and converted seismic waves, as well as
from transmission teleseismic tomography, further indicate a main magma chamber in the range 11-15 km with deeper roots under the volcano down to 30 km. The depth of this further magma chamber, as inferred by seismic studies, is also confirmed by geochemical estimations of crystallisation depths. Results of this work then presents the first complete model for the Somma-Vesuvius structure and magmatic systems, consistent with all the seismological and geochemical data.