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Neogene-Quaternary tectono-thermal events in the Tyrrhenian-Northern Apennines region

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The present-day tectonic setting of the central-northern Mediterranean can be interpreted as a result of a complex evolution, which has initially involved compression with lithosphere thickening and overthrusting, followed by dominant extension. Both processes have propagated eastward with time and accompanied the development of the Apennines fold belt at the outer margin of the Tyrrhenian basin. This has left a clear thermal signature which is well mirrored by the surface heat-flux pattern, whose lateral variations can be considered as both a piece of evidence and an interpretive key of the dynamic processes which have occurred in this area. In this paper, we focus on the thermal modelling of the different episodes of extensional and compressional tectonics, which since Miocene times have affected the Tyrrhenian-Northern Apennines region. The analysis of the spatial distribution and age of magmatism shows that three main extensional eastward-migrating tectono-thermal events, which have taken place within relatively small space and time intervals, can be recognised in the inner portion (Tyrrhenian and peri-Tyrrhenian zone). The oldest tectono-thermal event took place 14 Myr ago, whereas the second 7 Myr ago. The third and youngest rift episode, whose average age is 3 Myr, affected a wider area, including most of the peri-Tyrrhenian zone. The higher heat flux in the latter zone cannot be only explained by means of uniform stretching. We propose a thermal model in which lithosphere thinning is accompanied by the removal of 15 km of mantle lithosphere, as a result of eastward asthenosphere flow induced by the Adriatic lithosphere subduction. This gives a Moho temperature by 130 ˚C higher than that obtained with uniform stretching and accounts for the higher observed heat flux. The external zone of the northern Apennines shows deep structures resulting from compression and a very sharp drop of the heat flux. We modelled the thermal effects of the most recent thrust faulting

episodes by isolating the different sources of heat, namely the heat supplied from below the lower thrust plate, the radiogenic heating within the crust of both the upper and lower plates, and the frictional heating along the fault. For thrusting periods shorter than a few million years, cooling occurs at shallow depth, producing a decrease in the equilibrium surface heat flux.