Geophysical Research Abstracts
Vol. 20, EGU2018-8498, 2018
EGU General Assembly 2018

Mud volcano eruptions induced by Dynamic triggering: the 2016–2017 Central Italy seismic sequence case study

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On 24th August 2016 a seismic event (Mw 6.0) initiated the long Central Italy sequence (still ongoing at the early 2018) medium-to-high magnitude earthquakes, with several large seismic events, nine of which with a Mw $\geq$5 (up to October 2017), and with about 74.000 seismic events registered after 1 year. The largest earthquake was the Mw 6.5 30 October 2016 event near Norcia. After the major seismic events, 17 mud volcanoes erupted around Monteleone di Fermo village (Marche region). Interestingly, mud volcano eruptions in the Monteleone di Fermo area generally occurred a few hours to a few days after the main earthquakes, suggesting a possible seismic triggering. In order to investigate this possibility, we analysed the peak ground velocities and dynamic stresses during the three largest earthquakes (i.e. the Mw 6.0 near Amatrice, the Mw 6.5 near Norcia and the Mw 5.5 occurred in the Montereale-Capitignano-Campotosto area). Furthermore, we evaluated the static stress changes in order to assess the potential influence of normal stress changes on the feeder system (i.e. fractures array exploited by fluid to migrate upwards) of the activated mud volcanoes. We find a correlation with dynamic stresses, whereas static stress changes are negligible or negative (with values reaching -0.44 bar, and therefore clamping the feeder dykes). We conclude that seismic shaking (up to $\sim$3.9 bar during Norcia earthquake) is the dominant driver for these eruptions. Finally, we evaluated the response ratio as a function of the dynamic stress. It increases exponentially with peak dynamic stress varying from <10% for peak dynamic stress >0.3 bar to >50% for peak dynamic stress >2 bar, indicating a link between earthquake shaking and mud volcano activity.