Monitoraggio di sismicità antropica in Italia – Monitoring of anthropogenic seismicity in Italy

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Abstract

In Italy, the discussion about anthropogenic seismicity started after the deadly Ms 6.6 earthquake in 2012. Occurring these events in an area of gas and oil production, the question raised, whether stress perturbations induced by the exploitation may have triggered these events. In 2013, the Government published monitoring guidelines (IGe) describing regulations regarding hydraulic extraction, wastewater injection and CI storage. The IGc prescribe the monitoring of pore pressure, microseismicity and ground deformation near sites of industrial activity and direct the application of a four-stage traffic light protocol (tcl) has been charged to apply the IGc in three test areas and to provide indications about the applicability of these guidelines. We give a general overview about the state of the art, trying to emphasize critical situations as e.g. problems in magnitude estimation or traffic light thresholds, especially in areas with multiple ongoing risks.

Italian Guidelines for Monitoring effects of industrial activity on the subsurface

In Italy the Department of Environmental Protection and Research published a report about documented and hypothesized cases of triggered or induced seismicity in Italy (Fig. 1). Based on the report and on behalf of the Department General Affairs of Mining and Energy Activities – National Mining Office for Hydrocarbons and Geothermal Resources a group of experts compiled the "Italian Guidelines for monitoring the seismicity, underground deformation and pore pressure" (IGe, Delbroe et al. 2014). The IGe describe the monitoring regulations, especially regarding hydraulic exploitation waste water injection, and CI storage. A recent edition of the IGe concerning geothermal energy production was issued in June (Delbroe et al. 2016). Both guidelines prescribe standards for monitoring pore pressure, microseismicity and ground deformation and direct the application of a four-stage traffic light protocol, depending on magnitude, PCl and PClg (Fig. 2).

The IGe demand to report all events with magnitude M > 2.5 a) to manovaracetrace (i.e.) to monitor parameters and for M < 2.5 (light orange) b) no action is required, and for magnitude M < 1.5 (white) and it half industrial operations in case of events with M < 1.0 (green).

Experimental application of the IGe

In a three-years experimental phase, the IGe will be applied in each test area for different test activities (a) Injection of hydro-geothermal energy production (b) Waste water injection and CI disposal (c) Waste water injection and CI disposal (d) Waste water injection and CI disposal. In Italy hydraulic fracturing is not practiced, not only because the appropriate shale gas formation is lacking, but also because the technical commission of the Ministry of Environment outlawed the use of any type of fracking technique for hydraulic exploitation (Zanneli, 2013). The National Institute of Geophysics and Vulcanology (INGV) has been charged of managing manovaracetrace monitoring, or to act in an evaluation agency. In these test areas, and to provide indications about the applicability of these guidelines (Fig. 3).

Some remarks on the application of the IGe

Based on recent experiences made in Italy, the current seismic activity was studied by means of teleseismic and local magnitudes. In the future, the increase in the number of teleseismic events with magnitude M > 5 determined by real-time monitoring systems in Italy is expected to be a new horizontal monitoring system before starting the industrial operations (processed), which is instead impossible for already existing concessions, producing cases decades. With the forthcoming opening of the geographical term of many new concessions currently are expected to be situated inside or in the direct vicinity of the traditional areas of the main national energy producer, net including cases where different companies access the same reservoir: then the question raises whether the requirement to determine the zero line is reasonable. Another critical point of the IGc is the lack of any political consequence regarding the future production, or that the natural seismicity reaches the magnitude threshold already during the zero line period.

In the future, the zero line determines the magnitude of the maximum that may be allowed. In the near future, a local network will be set up for the geothermal exploitation site of Sannio Alpha (Fig. 4), these site is the only one in the world to date that has already been with magnitude M > 5 determined by real-time monitoring systems in Italy is expected to be one a new horizontal monitoring system before starting the industrial operations (processed), which is instead impossible for already existing concessions, producing cases decades. With the forthcoming opening of the geographical term of many new concessions currently are expected to be situated inside or in the direct vicinity of the traditional areas of the main national energy producer, net including cases where different companies access the same reservoir: then the question raises whether the requirement to determine the zero line is reasonable. Another critical point of the IGc is the lack of any political consequence regarding the future production, or that the natural seismicity reaches the magnitude threshold already during the zero line period.

Conclusions

Beyond the monitoring purposes, the experimental application of the IGe offers the great opportunity to access high-quality data allowing to outline criteria for the discrimination between natural and anthropic seismicity. One of these might be to invert the full-moment tensor (cesca et al. 2013) also for low magnitude events (Fig. 5). Further investigation could be to verify the hypocentral depth by alternative methods, e.g. depth phase modeling by comparing synthetic seismograms with the seismograms acquired at a group of sites.

References


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