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Engineering geological mapping of near-surface rock mass quality of folded and thrusted arenaceous flysch units in the Northern Apennines (Italy)

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The regionalized knowledge of the quality of near-surface rock masses is an important tool for land management/planning, as well as for guiding further in-depth studies aimed at landslide and earthquake risk assessment and civil engineering planning. The characterization of heterogeneous rock masses like flysch units represents a relevant challenge to engineering geologists due to the complex structure of these materials, which results from both their depositional context and tectonic history. Flysches are widespread all over the Apennines chain and their mechanical characterization is a difficult task given the occurrence of intercalation of layers with different lithology and strength. Moreover, the complexity of the thrust and fold tectonic framework makes the regional distribution of these characters difficult to predict. The aim of this work is to provide a method to map the near-surface rock masses quality for an arenaceous flysch widely cropping out in the outer Northern Apennines (Torrente Carigiola Formation, Aquitanian; Bettelli et al., 2002). This formation is mapped in both the geological map of the Regione Toscana (Italy) at the scale of 1:10,000 and the geological sheet "252 – Barberino di Mugello" (Bettelli et al., 2002) of the Italian Geological Map at the scale of 1:50,000 (CARG). It is made up by intercalated arenaceous (A) and pelitic (P) layers characterized by variable A/P ratio. The rock mass quality is evaluated by estimating, for a set of representative rock outcrops, the Rock Mass Quality Index (RQI; Disperati et al. 2016; Mammoliti et al. 2018). This index results from the analysis of both systematic Schmidt hammer rebound measurements (R) acquired at the nodes of a regular grid (ca. 20 R measurements for ca. 15-25 nodes) and the determination of the unit weight for representative outcrop rock samples. For the same outcrops, also the A/P ratio and bedding attitude are determined. The results show a positive linear correlation between RQI and the A/P ratio, confirming that the latter parameter is an important feature controlling the rock mass strength. This correlation is used to assess the distribution of both parameters within a set of geological cross sections traced normal to the regional structures trend (main thrusts and km-scale folds). Then, the structural features available from the literature geological maps allow us to extrapolate both the RQI and A/P ratio from the profiles to the map scale. Finally, a further set of the same rock outcrop data acquired after the above-described modelling procedure is used to check the accuracy of the method.