



## **Geological constraints on the “forma urbis” of Ariano Irpino (Italy)**

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Natural hazards can pose serious threats to the safety of citizens and have adverse consequences for social and industrial development, tourism, infrastructures and the environment. When earthquakes, volcanic eruptions, landslides intersect with densely populated cities, they become urban problems. Moreover, preventive measures can be hardly adopted when historical urban settlements are endangered; in these cases, coping with geohazards becomes a major task. This topic is here dealt with by analyzing the effects of slope instabilities on the urban setting of Ariano Irpino, which is the town affected by the highest number of landslides in the province of Avellino (Italy). Ariano Irpino falls within the Campanian segment of the southern Apennine chain, where Cainozoic clastic sediments, belonging to the Ariano Unit, crop out. In fact, sands and subordinate sandstones characterize the subsoil of Ariano, which represent a member of a Lower-Middle Pliocene regressive cycle. The areas has to be considered as seismically active: about 20 earthquakes have hit the Ariano area from the 9th century onward. However, no seismically induced landslide has been reported. The ancient urban nucleus of Ariano (whose birth dates back to 6th century) is located on the top of a hill, at about 820 m a.s.l. and is entirely bordered by high-angle up to vertical slopes, affected by a variety of instabilities. The sandy nature of the cliffs, in fact, favours a severe linear incision, which results into deep gullies, delimited by 30-35 m high inner slopes, especially in the south-eastern portion of the inhabited area. The gullies show a clear retrogressive tendency, also testified by multi-temporal air-photo interpretation and by comparison between present-day and historical topographical maps. Archival sources further confirm the high rate of slope retreat at Ariano, as in the case of the

so-called “Fosso di Anzani”, which appeared in the urban topography not earlier than the end of 18th century. Landslides also contribute as one of the main morphogenetic factors responsible for the shape of the urban area of Ariano. Falls and topples detach from the high-angle scarps, where sub-vertical tension cracks, often parallel to the slope, favour the instability of the sandy formation. On gentler slopes, where the bedrock formation is mantled by weathered products, slides can occur. The initial fall, topple or slide can eventually evolve into a debris flow, which can greatly increase the overall mobilized volume. Rainfall events and footslope river undercutting can be recognized as the main triggering factors of the slope instabilities. However, recent episodes occurred during dry periods and not related to river morphodynamics, induce to hypothesize different causal mechanisms. In this paper, after a reconstruction of the main instability events which caused the progressive shape evolution of the Ariano urban area, some considerations are spent as regards the hazard existing for the settlements close to the slope rims. Finally, an overview of the ongoing and designed remedial measures is given, which allows to evaluate to what extent “living with landslides” at Ariano is possible.