SEISMIC MICROZONATION
Level 1

Geological-Technical Map

1:5,000 scale

Avezzano town (AQ)
Fucino basin (central Apennines)

Geological Units
(reference: CARG 1:50.000, F° 368 Avezzano)

Quaternary Geological Units

- **dis** — **Dump (dis)**-*Holocene*
- **ant** — **Anthropic (ant)**- Anthropic structures and backfill material with mixed grainsize, the prevailing texture is gravel. *Holocene*
- **Fra** — **Landslide deposits (Fra)**- *Holocene*
- **Col** — **Eluvial-colluvial deposits (Col)**- Deposits characterized by heterogeneous textures: low- to medium-dense gravels and sandy gravels in a silty-clayey matrix; low to medium-densesilty sands; firm and reddish clayey silts, gravel clasts are often present. *Upper Pleistocene - Holocene*

Alluvial and fluvio-glacial deposits (All)

- **All3** — **Recent or hystorical (All3)**- rounded to sub rounded calcareous gravels, loose or slightly cemented, sands and slightly silty sands constituting the San Pelino alluvial fan and other alluvial deposits of the CARG map. *Upper Pleistocene p.p. - Holocene*
- **All2** — **Alluvial deposits of the Celano and Valle Majelama alluvial fan (All2)**- rounded to subrounded calcareous gravels and sandy gravels in a sandy matrix, occasionally stratified. The compactness is high and in some cases they are cemented. These deposits correspond to the huge alluvial fans of Valle Majelama and Celano (Giraudi, 1990; Frezzotti and Giraudi, 1992) and to the synthem «*Sintema di Valle Majelama*» of the CARG map. *Upper Pleistocene*

Slope deposits (Ver)

- **Ver2** — **Slope deposits (Ver2)**- Medium- to coarse-grained bodies of loose to dense slope derived calcareous gravels in a sandy-silty matrix. The matrix is brown to dark-red and vary from very abundant (matrix-supported) to absent.They crop out at the base of both carbonaceous reliefs and ancient breccias escarpments, forming covers of variable thickness and sometimes organized as mixed fan (alluvial and gravitative). *Upper Pleistocene - Holocene*
- **Ver1** — **Ancient gravitative breccias (Ver3)**- Massive or roughly stratified slope deposits showing a prevailing gravitative origin. Three lithotypes can be identifyed: 1) whitish calcareous breccias characterized by the absence of the matrix and a minor degree of cementation respect to the other lithotypes (cropping out in the Antrosano, Castelnuovo and Paterno); 2) well-cemente calcareous breccia, with angular and hetero-metric clasts, in a calcareous sandy or microconglomerate matrix having a calcareous origin; 3) stratifie calcareous breccias in a silty red matrix cropping out in the upper part of the stratigraphic sequence («*brecce rosate*» *Auctorum*). The lithotypes 1) and 2) are interbedded with or contain lenses of the Lac1 deposits (San Pelino, Antrosano and Paterno). They correspond to the «*Brecce di Sant'Onofrio*» of Bertini and Bosi (1976), «*Brecce Antiche*» and «*Depositi del 1° ciclo fluvio-lacustre*» of Zarlenga (1987), «*Complesso di Aielli (brecce ad elementi calcarei)*» and «*Brecce di Bisegna*» of Bosi et al.(1993), «*Supersintema di Aielli-Pescina*» of the CARG map.*Lower Pleistocene - Middle Pleistocene*

Lake and marsh deposits (Lac)

- **Lac3** — **Recent and Hystorical lacustrine deposits (Lac3)**- Grey-bluish, clayey silts passing upward to pale silts and sandy silts with sand interbeds, peat and pyroclastic levels. They are firm to moderately firm. They correspond to the «*Complessi I, II, II, IV*» of the «hystorical lake depression» of Giraudi (1999) and to the Holocene lacustrine and marsh (*olo*) of the CARG map. *Upper Pleistocene p.p. - Holocene*
- **Lac2** — **Lacustrine deposits (Lac2)**- Rounded gravels with scarce or no matrix typical of lacustrine shoreline, alternating sandy gravel and gravelly sand of lacustrine deltaic facies and silts, silty sands and sands of lacustrine facies. The silts are firm to moderately firm, the gravels are dense to moderately dense. They correspond to the shoreline lacustrine sediments of the «*Spianata di Pescina*» of Giraudi (1988, 1999) and to the «*Sintema di Valle Mjelama*» of the CARG map. *Upper Pleistocene*
- **Lac1** — **Ancient lacustrine deposits (Lac1)**- Alternating grey or yellow-greenish silts and clayey silts, firm to stiff with minor interlayers of yellowish micaceous sands. The reddish sandy and sandy-silty deposits, moderately dense, cropping out in the foothills of thewestern part of Avezzano (between 730 and 780 m a.s.l.), are attributed to this unit. They correspond to the «*Limi e sabbie di Paterno*» of Bertini and Bosi (1976), «*Depositi del 1° ciclo fluivio-lacustre*» Zarlenga (1987), «*Complesso di Aielli-Pescina*» of Bosi et al. (1993) and to the «*Sintema di Aileii-Pescina*» of the CARG map. Lower *Pleistocene - Middle Pleistocene*

Marine Geological Units (pre-Quaternary)
(the nomenclature complies the CARG terminology)

- **UAP** — **Pelitic-arenaceous unit (UAP)**- Alternating lithotypes constituted by siliciclastic turbidites in the pelitic-arenaceous association (S/C < 1) with minor arenaceous-pelitic layers. *Lower Messinian p.p.*
- **UAM** — **Clayey-marly unit (UAM)**- In the lower part, yellowish marly calcarenites showing lozenge structures and thick to very thick layering with trace fossils (Cylindrites), lamellibranch (pectinidae, ostreidae), glauconite and ferrous oxides (*Marne a Cylindrites Auctorum*). In the upper part, thin layered, grey marls with planctonic foraminifera (*Marne a Orbulina Auctorum*). *Upper Serravallian - Tortonian p.p.*
- **CBZ** — **Calcari a briozoi e litotamni CBZ)**- Limestones constituted by grey or withish-grey rudstones-grainstones characterized by very thick, not well-defined layers and abundant Bryozoa and Lithotamnium. *Langhian - Serravallian*
- **CFR** — **Calcareniti a macroforaminiferi (CFR)**- In the lower part, limestones constituted by white wackestones and packstones, massive or not well-stratified. The fossiliferous content is characterized by colonial corals, coralline algae and small Lithothamnium (Pseudolithothamnium album). In the upper part, Operculine and Discocycline fragments are present. Resedimented cristalline limestones (CTN) are present ate differet levels. In the upper part, limestones constituted by (from bottom to top): a) beige, stratified grainstones-rudstones with Discocyclina followed by white bioclastic and massive rudstones with abundant Nummulites; b) beige, marly calcarenites responsible for the formation of morphological steps; c) alternating well-stratified, beige, fine calcarenites characterized by medium to thick layers, and rudstones-grainstones with Nummulites and Discocyclina. *Thanaetian - Priabonian*
- **CTN** — **Calcari cristallini (CTN)**- Limestones constituted by white, bioclastic rudstones, massive or not well-stratified. They contain abundant fragments of bivalve and Radiolitidae, often roundend and isoriented, generally with high porosity. At the base of the stratigraphic sequence (M. Unomo), below the above mentioned facies, a layer, one-meter thick, of fine-grained bioclastic and microclastic limestones crops out. This layer rests on massive rudstones containing fragments of Radiolitidae. *Cenomanian p.p. - Maastrichtian*
- **RDT** — **Calcari a Radiolitidi (RDT)**- Limestones constituted by white-beige mudstones showing medium to thick layers and rare bioclastic intercalations. Radiolitidae-rich layers are present at different levels. *Upper Turonian - Santonian p.p.*
- **IBX** — **Calcari intrabauxitici (IBX)**- Stratified limestones constituted by bioclastic mudstones and wackestones and characterized by the presence of paleosoils and emersion surfaces. Bauxite deposits are present at the base, with paleokarst cavities (1° bauxite layer *Auctorum*). Two karst and redded layers are present, at least, in the upper part (2° and 3° bauxite layers *Auctorum*). Cenomanian *p.p.*
- **BLS** — **Calcari bioclastici superiori (BLS)**- Limestones constituted by white-greenish, bioclastic grainstones-rudstones, massive or not well-stratified, with Orbitolina and rudists fragments (prevailing Caprinae). *Upper Aptian - Cenomanian p.p.*
- **CIR** — **Calcari ciclotemici a requienie (CIR)**- Limestones constituted by white-beige, peritidal and subtidal cyclic mudstones. White biomicrite with Requienia fragments in the upper part. Bauxite deposits are present at the top, with paleokarst cavities (1° bauxite layer *Auctorum*). *Upper Aptian - Lower Albian p.p.*
- **CMS** — **Calcari e marne a Salpingoporella dinarica e charophyta (CMS)**- Alternating micritic limestones and greenish clayey-marly layers, showing thin-medium layering and charophyta-rich levels. Salpingoporella dinarica is present within the calcareous layers. *Lower Aptian p.p.*
- **RCO** — **Calcari a requienie, caprotine, ostreidi (RCO)**- Limestones constituted by white mudstones and wackestones with thick layers and containing Miliolidae, fragments of Ostreidae, Requienia and Caprotinae. *Upper Barremian - Lower Aptian*
- **CCG** — **Calcari ciclotemici a gasteropodi (CCG)**- Limestones constituted by whitish-beige wackestones-packstones containig intraclasts, oncolites and dessication structures in the upper part of layers. Thick or very thick layers (100-150 cm) alternate with decimetric layers of oolitic, grey grainstones (Oolites are often broken and regenerated. Floatstones -wackestones layers with abundant gastropods (among which Nerinea) are present. In the upper part, layers of breccia with black clasts and layers of greenish, oolitic marls-clay can be observed. *Berrasian - Lower Barremian*

Litho-technic Units

Geologic bedrock

- **B1** - Stratified rocks, medium- to- very thickly bedded.
- **B4** - Stratified rocks, pelitic interlayers (25%-75%).
- **C1**–Granular, medium-to-poorly cemented bedrock. Grain-supported breccia and conglomerate.

Cover units

- **E1** - Uncemented, coarse granular soils. Cobbles and boulders.
- **E2** - Uncemented, coarse granular soils. Gravel
- **E3** - Uncemented, coarse granular soils. Sandy gravel
- **E4** - Uncemented, coarse granular soils. Sand
- **E6** - Uncemented, coarse granular soils. Silty sand and/or clayey sand
- **E7** - Uncemented, coarse granular soils. Sandy silt
- **F1** - Fine soils. Silt.
- **F2** - Fine soils. Clay
- **F3** - Fine soils. Clayey silt
- **F4** - Fine soils. Silty clay
- **G**– Anthropic origin deposits (ex.backfill, archeological strata, etc.) with heterogeneous texture and differente compactness/strength degree.

Compactness of granular deposits:
I - Dense
II - Moderately dense
III - Poorly dense
IV - Loose

Strength of cohesive deposits:
I - Extremely stiff
II - Very stiff
III - Stiff
IV - Firm
V - Soft
VI - Very soft

Particular textural features:
a - rock fragments with larger grainsize
b - interstitial, non cohesive finer fraction
c - interstitial cohesive finer fraction

Geomorphological elements

- Alluvial fan
- Active detrital slope (small thickness)
- Morphological scarp edge (H>20 m)
- Morphological scarp edge (H 10-20 m)
- Morphological scarp edge (H<10 m)
- Fluvial terraces edge (H>20 m)
- Fluvial terraces edge (H 10-20 m)
- Fluvial terraces edge (H<10 m)
- Scarp edge of controversial origin (fault scap according to some Authors, erosional according to others)
- Crest
- Sinkhole

Slope Instabilities

Activity status: Active	Activity status: Dormant	Activity status: Inactive	AREAL MORFOLOGIES - SLOPE INSTABILITIES (the area affected by slope instability is rapresented by polygons with different colors, according to the activity status)
			Rockfall/toppling(#)
			Rotational/traslational sliding
			Flow
			Complex
	x	x	Deep-seated gravitational slope deformations
		x	Soil creep

Notation: The area affected by active rockfall/toppling have been defined on the base of: a) structural and morphological evidence in the field, suggesting unstable conditions (qualitative expert judgment); b) presence of boulders at the base of the slope, evidence of past falls; c) geomechanic analysis suggesting unstable static conditions.

Potential slope instability for rockfall/toppling (source area) -
Corresponds to the area where condition (a) is fulfilled (#) (southern Tre Monti area).
In the southern part of the Avezzano town, it derives from the extension of the zones affected by rockfall/toppling (#) in layered geological bedrock, when the slope angle is ≥ 30°.

Structural Elements

- 35 Bedding attitude
- Active and Capable normal fault (dashed if inferred)
- Potentially active and capable normal fault (dashed if inferred)
- Normal and transtensive fault (dashed if inferred or buried)
- Undefined fault (dashed if inferred or buried)
- Normal and trastensive, buried fault inferred from seismic reflection data (from Cavinato et alii, 2002)
- 150 Isocrhone of the top of the bedrock (in milliseconds, TWT; datum plane 600 m a.s.l.) (modified from Cavinato et alii, 2002)

Volumetric joint count, Jv

8 <10 — 16 10-20 — 28 21-30 — 59 >30

The number inside the symbol indicates the punctual Jv value

Subsurface and Hydrogeological Elements

WITH water:
- Depth from the g.s. (m) of the well / Depth from the g.s. (m) of the water table
- Depth from the g.s. (m) of the bedrock / Depth from the g.s. (m) of the water table

WITHOUT water:
- Depth from the g.s. (m) of the well — Borehole or well NOT intercepting the bedrock
- Depth from the g.s. (m) of the bedrock — Borehole or well intercepting the bedrock

Note that in the Fucino basin there is a multi-aquifer system. Therefore, the water depth reported in wells is not always referred to the shallowest aquifer (often, only exploitable aquifers are indicated). An example is the area where Unit Lac3 crops out, where the water table is very close to the ground surface.

Mean seasonal water table < 15 m from ground surface

Other Elements

Evidence of past liquefaction

- Evidences of liquefaction after the 1915 earthquake (Oddone, 1915; Liquefaction catalog by Galli, 2000)
- Evidences of liquefaction from paleosismological studies (Castenetto & Galadini Eds, 1999)

A — A' Geological cross-section

Key for abbreviations

Lac2 E3 I — geologic unit (Lac2); litho-technic unit (E3); strenght/consistency (I)

0 100 200 300 400 500 m