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SEDIMENTOLOGY AND FABRIC CHARACTERISTICS OF SUBAERIAL SLOPE AND ALLUVIAL CONE DEPOSITS IN NORTHERN CALABRIA (SOUTHERN ITALY)

ABSTRACT: ROBUSTELLI G., SCARCIGLIA F. & MUTO F., *Sedimentology and fabric characteristics of subaerial slope and alluvial cone deposits in northern Calabria (Southern Italy)*. (IT ISSN 1724-4757, 2005).

This work focuses on the transport processes, sedimentology and clast fabric of slope deposits cropping out in active depositional environments, widespread between 900 and 1000 m in altitude, close to Mormanno, in northern Calabria. The climate is characterised by a mean annual temperature of about 10-12°C and a mean annual precipitation higher than 1500 mm; as a whole an *upland Mediterranean* climate (*Csb*-type) occurs.

The parent rock consists of strongly fractured Meso-Cenozoic limestones and dolostones with marly intercalations; rocky slopes are deeply incised by steep flanked V-shaped gullies, outlining a badland-like drainage network.

Two types of talus slope have been distinguished: (i) rock fall dominated (RF) and (ii) slope wash dominated (SW), located at the foot of rockwalls and downslope of large gullies, respectively.

A talus surface survey, coupled with observations made in trenches dug in the taluses at issue, allow us to describe lithofacies and to sample deposits for fabric analysis. RF talus slopes, showing well developed fall-sorting, consist mainly of alternating couplets of sheet conglomerates of pebble grade and lenticular pebbly sandstones. Clast fabric, grain size, grading and bed geometry suggest an alternation of rockfall and sediment-gravity flow processes in RF talus development. SW deposits show well developed bedding, inferred by grain-size variations; fabric, lamination and lenticular geometry have been referred to sediment-gravity flows plus fine-fraction winnowing.

To test the hypothesis that slope deposits are representative of the processes above mentioned, a-axis orientation and dip were measured on sets of 40 clasts. Data were treated according to the eigenvalue method, which allows to distinguish among cluster, girdle and random fabric patterns. In addition, the spherical variance (SVAR) has also been calculated, to obtain a further measure of fabric strength. All diagrams of fabric characteristics reveal overlaps of the fields representing different sedimentary processes; although girdle fabric shapes prevail, the fabric strength is thought to be a good discriminator for sedimentary processes assessment.

KEY WORDS: Sedimentology, Fabric characteristic, Fabric strength, Slope deposits, Northern Calabria (Italy).

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RIASSUNTO: ROBUSTELLI G., SCARCIGLIA F. & MUTO F., *Sedimentologia e caratteri strutturali dei depositi di versante e di conoide detritica in Calabria settentrionale (Italia meridionale)*. (IT ISSN 1724-4757, 2005).

Questo articolo mira a definire i caratteri stratigrafici, i processi sedimentari e la distribuzione spaziale dei clasti dei depositi di versante affioranti a quote comprese tra 900 e 1000 m s.l.m presso Mormanno (Calabria settentrionale). Il clima è caratterizzato da una temperatura media annua di circa 10°-12°C e da precipitazioni medie annue superiori a 1500 mm; questi caratteri climatici definiscono, per l'area in esame, una clima Mediterraneo montano (tipo *Csb*).

I depositi detritici sono prodotti dalla disgregazione fisica di rocce calcareo-dolomitiche intensamente fratturate. I versanti in roccia sono fortemente incisi da vallecole acclivi tali da delineare un paesaggio molto simile a quello calanchivo. Nell'ambito di questi sistemi vallivi sono state distinte due tipologie di accumuli detritici in funzione dell'efficacia dei processi di caduta di detrito (RF talus) e del ruolo operato dalle acque ruscellanti (SW talus); i suddetti corpi detritici sono ubicati rispettivamente alla base di scarpate o alla confluenza tra ampie vallecole secondarie ed il collettore principale.

L'analisi del detrito superficiale e delle sezioni artificiali hanno permesso di descrivere i caratteri sedimentologici dei depositi detritici e di effettuare le misure di orientazione spaziale dei clasti utili per l'analisi statistica. Gli accumuli detritici del tipo RF, caratterizzati da una evidente classazione inversa, sono costituiti principalmente da un'alternanza di letti ghiaiosi e lenti sabbioso-ghiaiose. La distribuzione dei clasti, la granulometria, la gradazione e la geometria dei livelli suggeriscono che i processi di stratogenesi siano da ricondurre ad un'alternanza di depositi di caduta e flussi di detrito. I corpi detritici del tipo SW mostrano una stratificazione ben evidente soprattutto grazie alle variazioni granulometriche dei livelli costituenti; l'embriciamento, la laminazione e le geometrie dei livelli, talora lenticolari, sono caratteri rappresentativi sia di processi massivi che trattivi.

Per confermare l'ipotesi che i depositi di versante analizzati siano dovuti ai suddetti processi sedimentari, è stata eseguita un'analisi statistica dell'orientazione ed inclinazione dell'asse maggiore dei clasti (a-axis). I dati ottenuti dalle stazioni di misura sono stati analizzati con il metodo degli autovalori; esso consente di distinguere tra distribuzioni di tipo *cluster*, lineari (*girdle*) e casuali. Inoltre, come ulteriore misura del grado di orientazione, è stata calcolata la varianza sferica (SVAR). I diagrammi ottenuti evidenziano una parziale sovrapposizione dei campi rappresentativi dei processi sedimentari ipotizzati; sebbene si nota una prevalenza di distribuzioni lineari (*girdle*), riteniamo che i valori del grado di orientazione siano uno strumento valido per discriminare i processi di stratogenesi.

TERMINI CHIAVE: Sedimentologia, Caratteri strutturali, Grado di orientazione, Depositi di versante, Calabria settentrionale (Italia).

INTRODUCTION

The formation of stratified slope deposits, widespread throughout mountainous areas, are generally considered to form in cold climatic conditions, in particular indicative of periglacial environments (Tricart & Cailleux, 1967). But they also occur at middle altitude of mediterranean mountain belts (Bertran & Texier, 1999), where stratified slope deposits are not exclusively related to cold climate, but mostly due to high-sloping topography. The hypotheses of their origin include several processes of debris transfer on lower slope; the processes commonly invoked are sediment gravity flows (debris and dry grain flow), solifluction, surficial creep and sheet wash processes amongst the others (Coltorti & Dramis, 1984, 1995; Van Steijn & *alii*, 1984, 1988, 1995; Bertran & *alii*, 1993, 1995; Bertran & Texier, 1994; Hétu & *alii*, 1995; Harris & Prick, 2000). Also sedimentological analysis (Bertran & Texier, 1999; Nemec & Kazanci, 1999) suggests the role of sediment-gravity flows, sheet wash and slush flows in stratified slope deposits development.

The analysis of fabric data has been also used to infer facies with contrasting depositional processes, particularly by researchers working on glacial deposits (Mark, 1973; Domack & Lawson, 1985; Dowdeswell & Sharp, 1986; Benn, 1994, 1995; Benn & Evans, 1996). More recently a number of attempts have been made and applied to stratified screes in order to identify sedimentary processes responsible of stratogenesis (Bertran & *alii*, 1997; Hinchcliffe & *alii*, 1998; Millar & Nelson, 2001). Although the clast fabric has to be used with caution (Bertran & *alii*, 1997), this note describes the sedimentology and fabric characteristics of stratified slope deposits cropping out in northern Calabria; also this work aims to compare the fabric data and sedimentological features for sedimentary processes assessment.

GEOLOGICAL SETTING

The study area is located at the boundary between northern Calabria and southern Basilicata (South Italy), where the Meso-Cenozoic carbonate successions of the Apennines are in contact with the crystalline Calabrian Arc. Ietto & *alii* (1992) suggest the occurrence of three main imbricate units (fig. 1A), described from bottom to top, as follow:

- the methamorphic «S. Donato Unit» consists of a lower terrigenous interval (Permian?-Early Trias) and an upper carbonatic interval (Trias);
- the «carbonate Platform Unit» is constituted by two tectonic subunits, both ranging from Trias to Eocene. They consist of neritic carbonates and pelagic deposits, showing the same kinematic evolution;
- the «Internal Units» complex is mainly represented by the Lower Ophiolite Unit (Liguride Complex, Piluso & *alii*, 2000).

Mountain building process of the study area started during Early Pleistocene, as the southern Apennines were affected by a severe strike-slip tectonics, which modified the previous folds and thrusts belt (Monaco & *alii*, 1998); during the Middle Pleistocene a purely extensional regime (Schiattarella, 1996) reactivated the pre-existing structures with different kinematics and uplifted the whole chain.

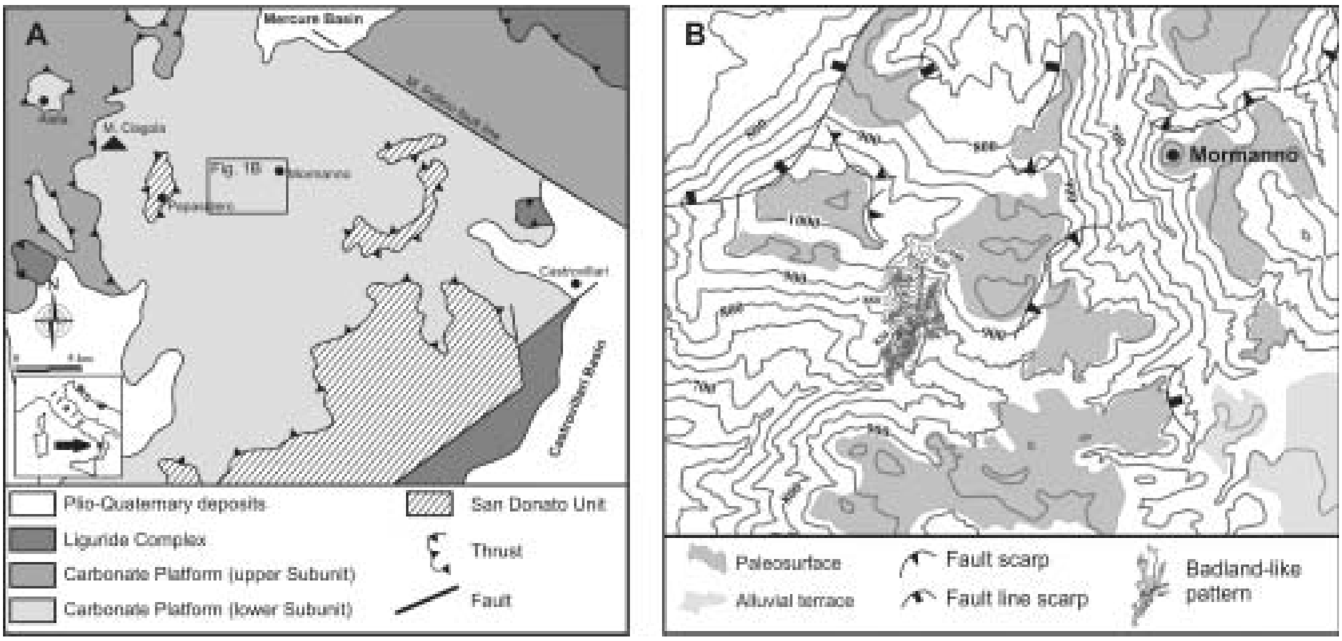

FIG. 1 - Geological map of north-western Calabria and location of the study area (A); geomorphological sketch map of the study area (B).

CLIMATE

The Calabria region has a typical Mediterranean climate, generally perhumid above 1000 m of altitude, with mean annual precipitation overcoming the mean value of the whole Italian peninsula (Versace & *alii*, 1989). In more details, a temperate humid climate (*upland Mediterranean climate* or *Csb*-type, Koppen, 1936) characterises the study area, where the dry season (summer) is cool and not particularly long (the average temperature of the warmest month is lower than 22°C). Mean annual temperature is 10-12°C, with mean monthly minima around –1°C (in January), and maxima of 16-18°C (August). Precipitation exceeds 1500 mm/year (Versace & *alii*, 1989; Colacino & *alii*, 1997), and spreads throughout the fall-winter season; important snow fall occurs at altitudes higher than 1400 m.

The main climatic parameters of this area suggest that chemical weathering and erosion tend to prevail among geomorphic processes (Sorriso-Valvo, 1988; 1993), according to the morphoclimatic perspective approached by Wilson (1969). In particular, intense karst dissolution is recorded by a wide variety of landforms and minor morphologies, although also the role of physical processes, such as thermoclastism and cryoclastism, can be supposed to be prominent.

GEOMORPHOLOGY

The relief of the study area mainly consists of variably wide, dissected and fragmented paleosurfaces, flat to gently-inclined, which constitute part of the highlands (fig. 1B). Different orders of these relict limbs have been tectonically uplifted to various heights (fig. 1B), ranging from about 700 to 1100 m a.s.l., and are carved across a calcareous bedrock. During Middle-Upper Pleistocene the study area experienced uplift (Schiattarella & *alii*, 1994; Bordoni & Valensise, 1998) that, coupled with river incision, caused increase of local relief.

The calcareous bedrock constitutes the substratum which sourced widespread scree deposits; as a response to their sedimentary history and following tectonic activity, carbonates exhibit stratigraphic discontinuities, shear zones or fault planes with different spatial orientation, and other irregularly-arranged fracture systems; these intersect and cause an intense rock grinding, which produces rock floors (fig. 2A). Joints may widen also for tree root growth, tree wind solicitation, water overpressure, karst dissolution, formation of ice needles or wedges in response to cyclical freezing/thawing phenomena. All the discontinuities (minor lithologic changes included) may become preferential ways for overland flow, which may concentrate, forming

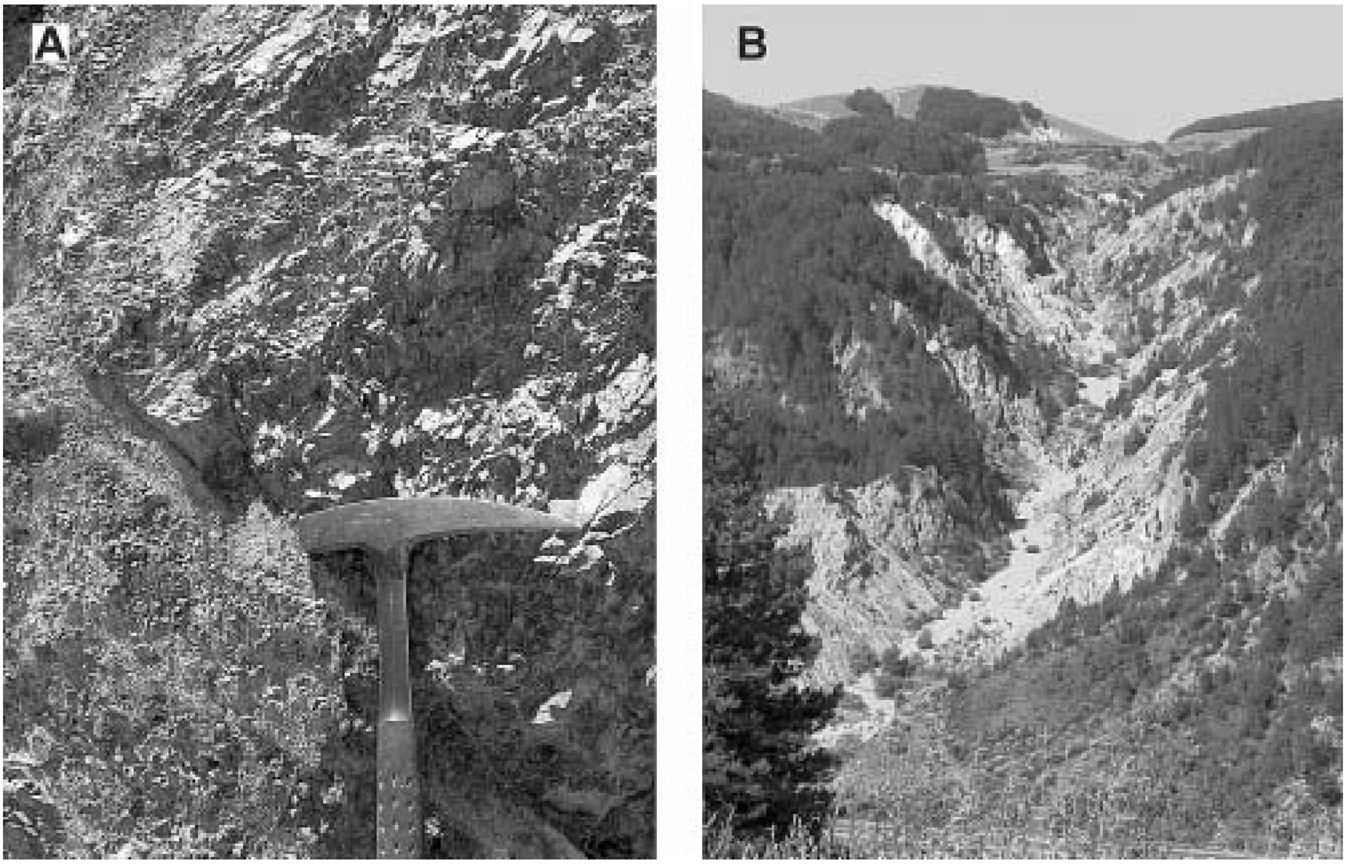

FIG . 2 -The intense rock grinding affecting the calcareous bedrock is widespread throughout the whole study area (A) and causes the development of deep valley resulting in a badland-like drainage pattern (B).

progressively deepening gullies; in fact, rocky slopes are deeply incised by steep-flanked, V-shaped valleys, which result in a badland-like drainage pattern (fig. 2B). Also the snow cover represents an important source of water supply, enhancing sheet-wash processes and mass movements, especially where it is preserved for prolonged time spans (sometimes even during late spring), within incisions or along shadowed slopes receiving minor insolation.

The above quoted discontinuities induce rock fragmentation into rock blocks, slabs or wedges, different in shape and size, which are therefore prone to failure; as soon as slope stability thresholds are exceeded, mainly on steep topographies (e.g. rockwalls), disjointed blocks fall or topple downslope, often undergoing further fragmentation. Moreover, where a soil cover is present, it is usually very thin (centimetre- to decimetre-thick), brown-coloured as humus enriched and weakly differentiated, possibly with abrupt, lithic lower boundaries towards the carbonate bedrock or including abundant coarse rock fragments. These features are consistent with intense surface erosion and reworking phenomena, mainly occurring where a protective vegetation is lacking or slopes are particularly steep: slope wash processes are promoted, greatly overcoming chemical weathering (karst dissolution in particular), and possibly inducing further degradation of soils and vegetation. Furthermore, the soil cover may show evidence of creep and solifluction or be affected by occasional shallow landslides detached at the soil/bedrock boundary.

The Mormanno talus slopes

In the study area two types of talus slopes have been distinguished: (i) rock fall dominated (hereinafter called RF) and (ii) slope wash dominated (hereinafter called SW), located at the foot of summit cliffs and downslope of large gullies, respectively (fig. 3). In particular, we report the results of our research on the active scree deposits cropping out in the upper reaches of drainage basins, during a one-year survey.

The *RF talus* accumulations comprise both talus cones and talus sheets (fig. 3A), widespread below rock gullies and undissected cliffs, respectively; the difference is due to a more or less uniform delivery of rockfall debris.

The rockwall has a mean inclination of 73° and its present height locally attains to 15 m. Below the walls, the talus accumulations show an essentially rectilinear slope: its mean gradients, along the transect surveyed, range from 36° to 42°. Sometimes it is characterised by an upper rectilinear segment with a mean inclination of 37° and a downslope concave segment. Talus maturity is indicated by the H_o/H_i ratio (Statham, 1976), where H_o is the vertical height of the talus and H_i is the height of the entire slope (talus plus rockwall). The mean H_o/H_i ratio for the RF talus slopes investigated is 0.37, reflecting the low maturity of the sedimentary system; these talus slopes have been chosen for statistical data treatments.

The talus displays a general downslope increase in the size of surface clasts (fall-sorting); the mean clast size ranges from 0.7 cm at the talus apex to 3.6 cm at the talus foot. RF taluses with higher H_o/H_i ratio are characterised by a fining upward trend and by higher amount of fine fraction.

The *SW talus* accumulations consist of locally dissected alluvial cones (fig. 3B), developed below a tributary gully network, also causing aggradation of the main trunk. Tributary valleys have a mean inclination of 22°, and locally

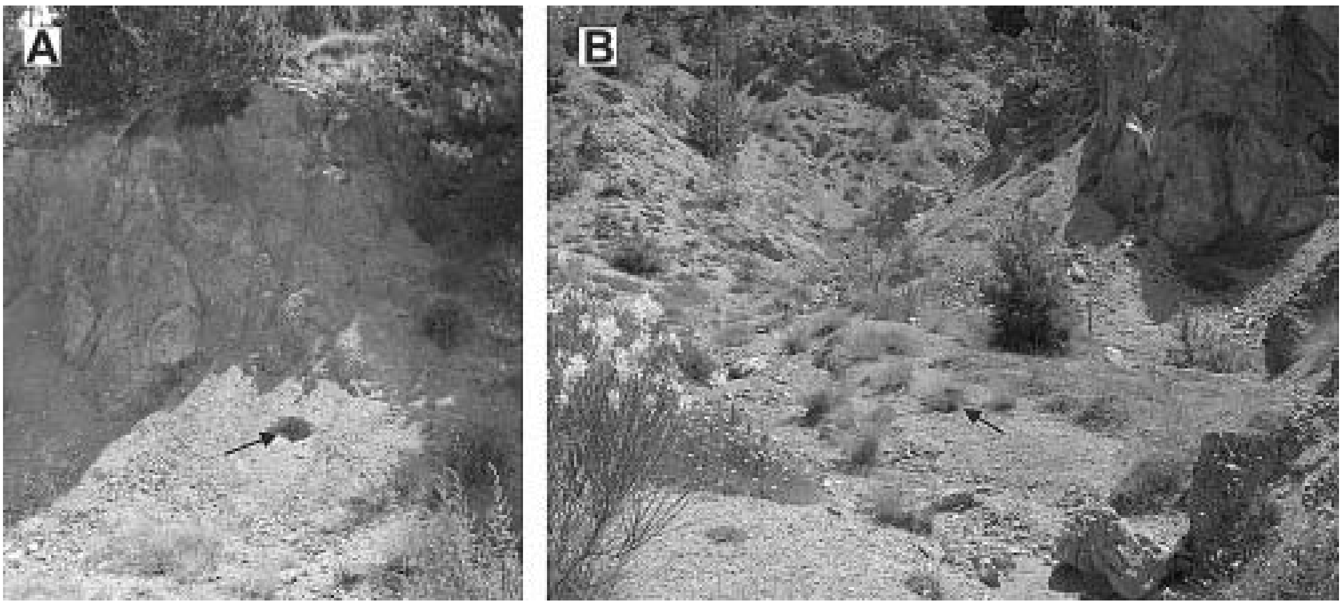

FIG. 3 - The two type of talus slope distinguished in the study area. (A) RF talus; (B) SW talus. (see hammer - arrow - for the scale).

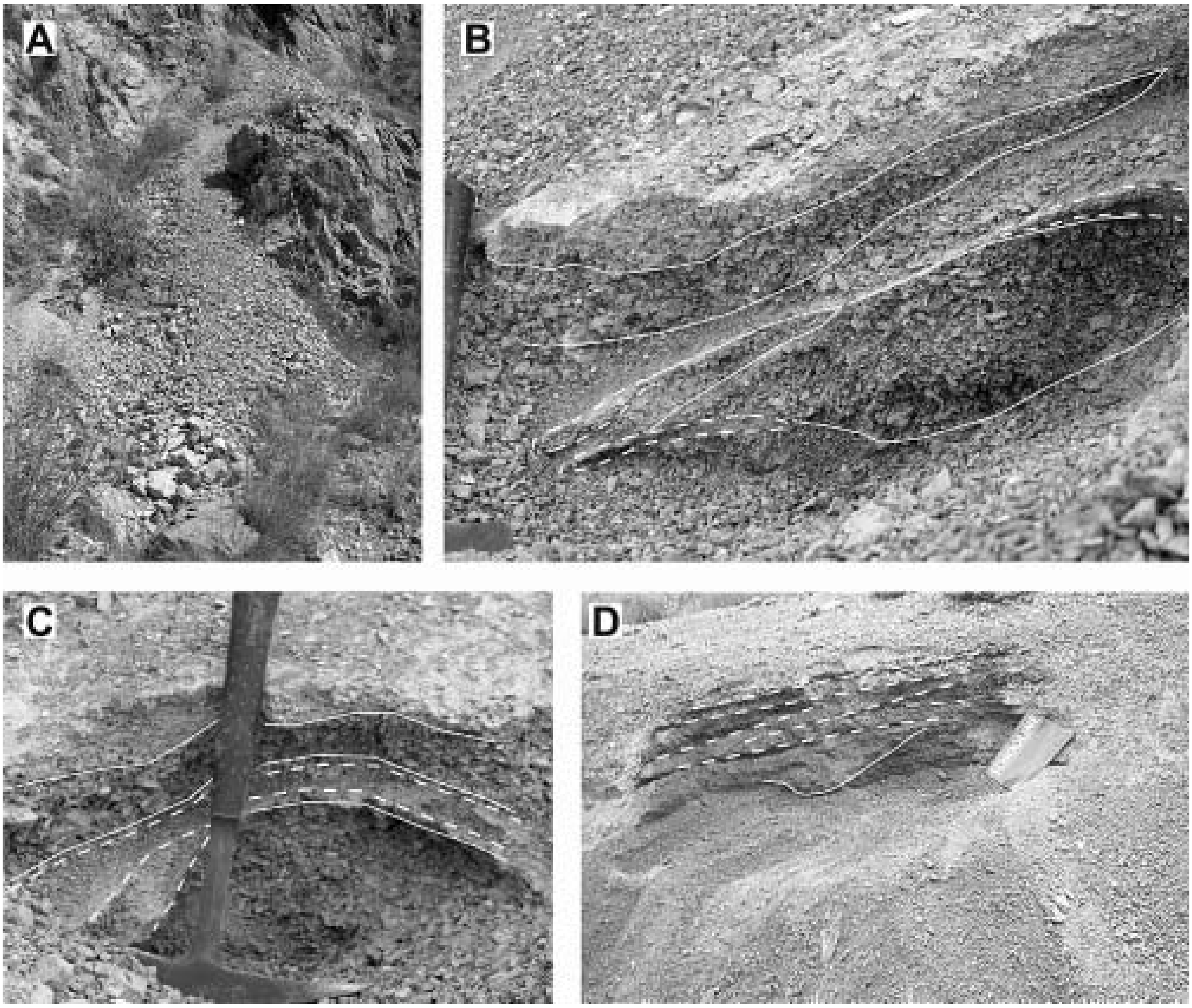

FIG . 4 - Dry grain-flow deposits (on the right of the hammer) descending RF talus surface (A); longitudinal (B) and transverse (C) section of RF talus deposits; we can distinguish sheet debris beds of granule to pebble grade (solid lines) alternating with lenticular and sheet pebbly sandstones (dashed lines); basal truncations (dashed lines) characterise cm-thick couplets of coarse and fine-grained sheet debris beds (D).

develop up to the watershed. The talus accumulations show a rectilinear slope, with a mean inclination of the transect surveyed ranging from 8° to 12°.

The talus surface displays no downslope change in clast size, falling in the granule to pebble range.

Stratigraphy and internal structure

Twelve vertical sections, up to 1 m deep, were excavated in talus accumulations, eight trenches dug into RF taluses and four trenches into SW taluses.

The survey of RF talus surfaces allowed lobes to be found (fig. 4A); their main morphological features are levees, locally well developed, frontal lobes and channel-bottom deposits. Lobes are interpreted as sediment gravity flow - grain flow - deposits, caused by the overloading and oversteepening of abundant debris supply at the talus apex; field surveys indicated that locally grain flow processes were triggered soon after rockfalls and induced reworking of surface deposits. Furthermore, the occurrence of lobate forms below small incisions suggests that debris flow processes also occur.

All excavated sections into *RF talus* deposits were cut in the mid-slope zone. Sections reveal that deposits consist of stacked sediment units of variable texture, whose top surfaces are aligned approximately to the talus surface (fig. 4B); a fining upward trend has been also observed. Contacts are conformable over short distances, but layers pinching out both downslope and upslope were observed (figg. 4B and 4C).

In particular, all sections are mainly composed by sheet debris layers of granule to pebble grade, in some cases pinching out upslope, and locally displaying a clear downslope coarsening trend of clasts (solid line in figg. 4B and 4C). They are moderately to poorly sorted, with a partially openwork texture. Matrix content is generally low and consists of coarse sand and granules. Conglomerate fabric is disorganised. The above quoted features may be indicative of rockfall deposits.

The interlayered sediments are dominated by moderately sorted, lenticular and sheet debris beds, with a partially openwork and/or clast-supported texture (*sensu* Wasson, 1979). Debris clasts range from coarse sand to fine pebble in size. Sometimes they consist of stacked lenticular units, locally displaying a convex-top boundary (dashed lines in figg. 4B and 4C); some lenses contain slope-parallel clasts and exhibit inverse grading. Matrix content is high, and consists of fine sands and silt. These deposits have been interpreted as sediment-gravity flow processes (grain-flow and debris-flow), emplaced during reworking of earlier sediments from upslope.

The *SW talus* accumulations include well stratified beds composed of debris of sand to fine pebble grade: these deposits show millimetre to centimetre-thick lenses, consisting of fine sand to granule-size clasts, interstratified with centimetre-thick, sheet debris layers of granule to pebble grade (fig. 4D). The last ones may consist of vertically alternating couplets of coarse and fine-grained, clast-supported sheet debris layer, with sharp and non erosive basal bedding contacts. It is worth to note that couplet units are characterised by basal truncations which envisage a low-angle stratification (fig. 4D); these beds have been chosen for statistical data treatments. Although scarse, shallow scour surfaces have also been observed. Sheet debris layers are moderately to well sorted, with a partially openwork texture; in some cases debris beds are graded, but also massive, ungraded beds are recurrent.

The dominance of parallel stratified debris beds, locally characterised by vertically alternating couplets of coarse and fine grained beds, indicates that extensive, high-energy depositional processes were involved. As a whole, this facies is interpreted as representative of sediment-gravity flow processes, as also suggested by *a*(p)*a*(i) and *a*(p) fabric mode (clast a-axis parallel – p – and/or inclined – i – to transport direction) and inverse grading. Lenticular units may be representative of deposition in small channels that developed over slope surfaces and produced fine-fraction winnowing of sheet conglomerates.

Fabric shape distribution

The «eigenvalue method» has been widely adopted as a standard method for summarising sedimentary fabrics, i.e. a three-dimensional analysis of clast attitude; in addition, this method has been widely applied to distinguish sedimentary facies on talus slopes, and significant progress has been made in interpreting them in terms of depositional processes (Bertran & *alii*, 1997; Hinchcliffe & *alii*, 1998; Millar & Nelson, 2001). Eigenvalues can reduce large data sets to simple descriptive statistics, describing the strength and orientation of directional properties of a sediment, thus allowing the comparison of fabric data from different sites. The procedure is widely dealt with by Woodcock (1977) and Woodcock & Naylor (1983).

Briefly, strike and slope values of a data sample can be expressed as a set of three direction cosines (l = cos (dip) x cos (strike); m = cos (dip) x sin (strike); n = sin (dip)); then the products can be summed to give the orientation tensor (3x3 matrix). Eigenvalues will be computed through this matrix and normalized (divided by number of measurements); finally eigenvalue ratios will be computed and plotted. Davis (1973) suggests some routines to perform eigenvalue analysis.

According to Woodcock (1977), fabric shape can be characterised by calculating eigenvalue ratios $r_1=\ln(S_1/S_2)$ and $r_2=\ln(S_2/S_3)$ and plotting the results in a r_1-r_2 diagram; the ratio $K=r_1/r_2$ gives the gradient of straight lines radiating from the origin, discriminating between cluster and girdle fabric shape. The parameter $C=\ln(S_1/S_3)$ is the measure of the strength of the preferred orientation: higher values of C, indicating higher fabric strength, plot further from the origin of the diagram. In addition, the spherical variance (SVAR) has also been calculated (*e.g.* Davis, 1973, pp. 330-334); it reflects the dispersion of the data vectors around the eigenvector corresponding to the largest normalised eigenvalue (S_1). SVAR is a further measure of the fabric strength: high values indicate strong dispersion or low fabric strength.

Results

To test the hypothesis that slope deposits are representative of the above quoted slope processes, a-axis orientation and dip were measured on sets of 40 clasts. Data were treated according to the eigenvalue method and also tested by calculating the spherical variance (SVAR).

As far as *RF talus* is concerned, only coarser layers have been sampled. In a r_1-r_2 diagram (fig. 5A), the samples plot below the line r_1=1, most r_1 values ranging between 0.2 and 0.6. Fabric shape and low fabric strength (C<2) indicate that clast a-axes are randomly placed on the stratification plane; as a consequence, the spherical variance (SVAR) is high, also depending upon the compact clast shape (fig. 5B).

The r_1-r_2 diagram of *SW talus* (fig. 5C) shows that fabric shapes tend to develop a girdle fabric, but C values are on average higher than RF talus data. The samples also show low and high fabric strength values in equal proportions, which mean that a clustering of clast a-axes around the slope direction may locally occur; accordingly, the values of SVAR are in a relatively wide range (fig. 5D).

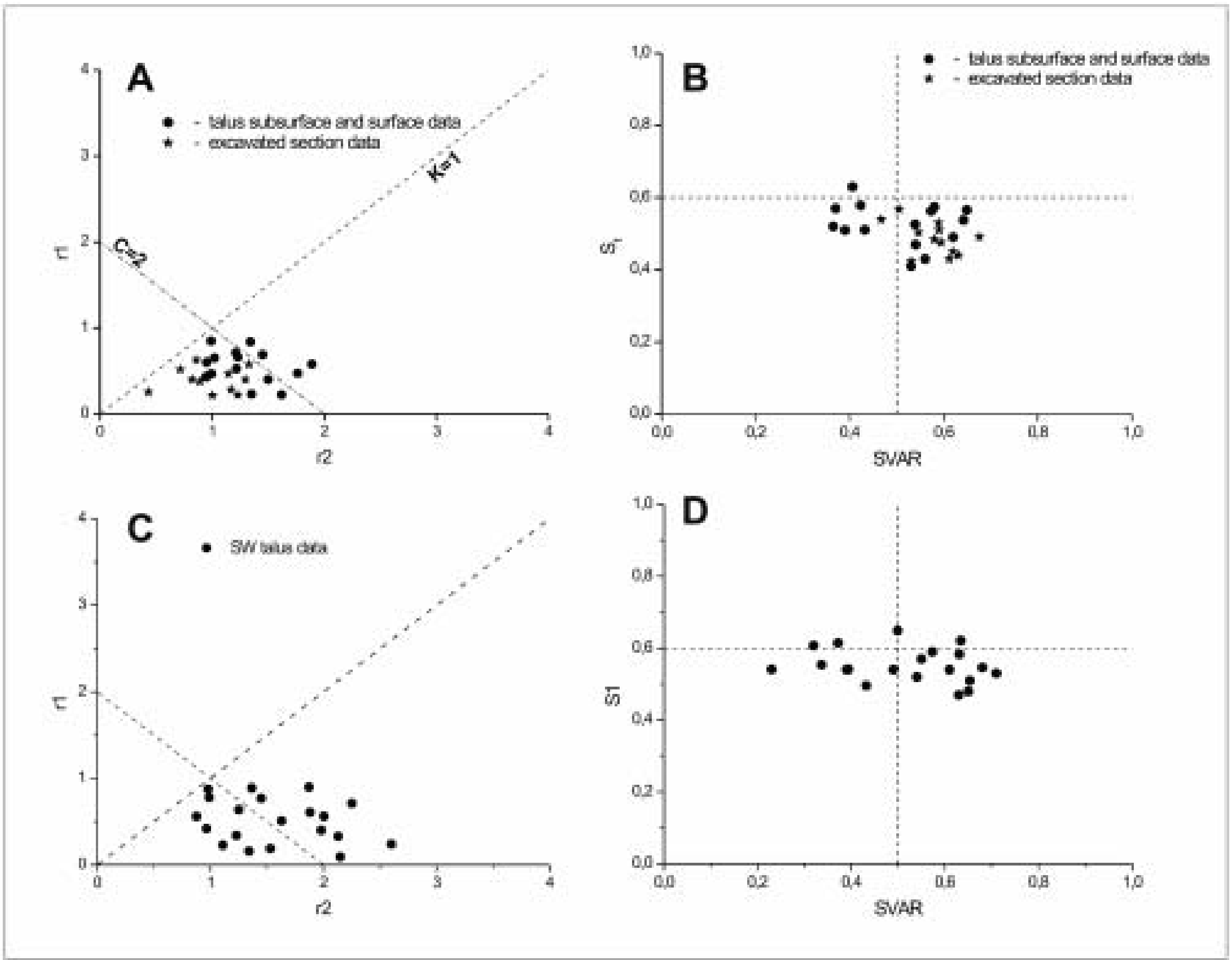

FIG . 5 - Fabric plots of the surveyed talus deposits. Eigenvalue ratios depicted on r1-r2 plots (A, C); fabric plots of S_1 versus SVAR (B, D). See text for explanations.

DISCUSSION

As already discussed in Bertran & *alii* (1997), all diagrams of fabric characteristics reveal overlaps of the fields representing the above quoted sedimentary processes.

According to Bertran & *alii* (1997), the fabric shape is not a good discriminator, as both r_1-r_2 diagrams show a clear tendency to develop girdle fabrics. Furthermore, both groups of talus deposits are generally characterised by low values of S_1 and r_1, which suggest that the orientation distribution is more or less random. But SW talus slopes show a moderately strong fabric and relatively low SVAR values, which can be considered as typical of «collective» particle movements. In particular, r_1-r_2 diagram shows a slight increase of the fabric strength toward RF talus surface and SVAR values are accordingly low (figg. 5A & B); this is thought to be caused by an increase of «collective» particle movements due to the role played by the presence of abundant fines. In particular, the fining upward trend, locally characterising these slope deposits, reflects the progressive accretion of screes and the retreat of rockwall. The progressive burying of rockwall foot causes a decrease in coarse debris supply on behalf of fines sourced by the severe fragmentised bedrock (fig. 2A). Also the hypothesis that a lengthening of the transit surface may promote clast fragmentation (Bertran & *alii*, 1995) may not be ruled out. The decreasing grain size is important in facilitating failure and flow of debris on talus slope apexes (fig. 4A), as build-up of porewater pressure occurs; also creep and/or solifluction processes affecting the talus deposits cause the overloading and oversteepening of the talus surface, leading to dry grain flow occurrence. Consequently post-depositional fabric modifications, due to sediment gravity flow processes (grain flow and debris flow), are thought to be responsible of the increase of fabric strength and of the decrease of SVAR values in RF taluses. The S_1-SVAR diagram may also suggest that the role of runoff cannot be ruled out, as small incisions, locally affecting talus surfaces, have been observed.

As a whole, the above quoted findings, coupled with internal structure and sedimentological characteristics, suggest that the RF talus slopes are not the product of rockfall events only, but also the role of sediment-gravity processes is prominent in explaining the development of such slopes.

CONCLUSION

Active slope deposits, cropping out in northern Calabria, have been surveyed in order to characterise their sedimentology and fabric characteristics. Two types of talus slope have been distinguished: rock fall dominated (RF) and slope wash dominated (SW).

The RF talus slopes are characterised by well developed fall-sorting and are composed of sheet debris beds of pebble grade alternating with finer grained lenticular and sheet debris beds; matrix content is moderately high. Facies analysis suggests that RF slope deposits can be the result of both rockfall and sediment-gravity processes.

The SW talus slopes consist of well stratified beds, characterised by millimetre-thick lenses of fine sand to granule grade and centimetre-thick, sheet conglomerates of granule to fine pebble grade. The dominance of horizontally stratified conglomerates, locally consisting of alternating couplets of coarse and fine grained beds, are representative of high-energy processes (sediment-gravity flow).

To test the hypothesis that the slope deposits at issue are representative of the above quoted sedimentary processes, data concerning the azimuth and dip angle of the clast a-axes were treated according to the «eigenvalue method». The spherical variance (SVAR), a further measure of the fabric strength, has been also calculated.

Although diagrams of fabric characteristics reveal overlaps of the fields representing different sedimentary processes, the fabric strength, and partly SVAR values, is thought to be a good discriminator of the processes responsible of the RF and SW talus development. In fact, the RF talus slopes are always characterised by values of the largest eigenvalue and of the fabric strength in average lower than the SW talus deposits; consequently, the mean SVAR values are relatively higher. Furthermore, the results reported above, *i.e.* both sedimentological and statistical data, envisage the RF talus development in terms of a combination of rockfalls and debris transfer through sediment-gravity processes, especially where the maturity of the depositional system - H_o/H_i ratio - was higher.

The examples of fabric characteristics derived from active slope processes in northern Calabria show overlapping values, confirming that clast fabric has to be used with caution (*e.g.* Bertran & *alii*, 1997); nevertheless, the findings reported in this paper suggest that clast fabrics, coupled with facies analysis, constitute a useful tool for the recognition of active slope processes responsible of talus development.

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