Petroplinthite formation in a Quaternary complex paleosol along NW Italian coast: from micromorphology to landscape evolution.

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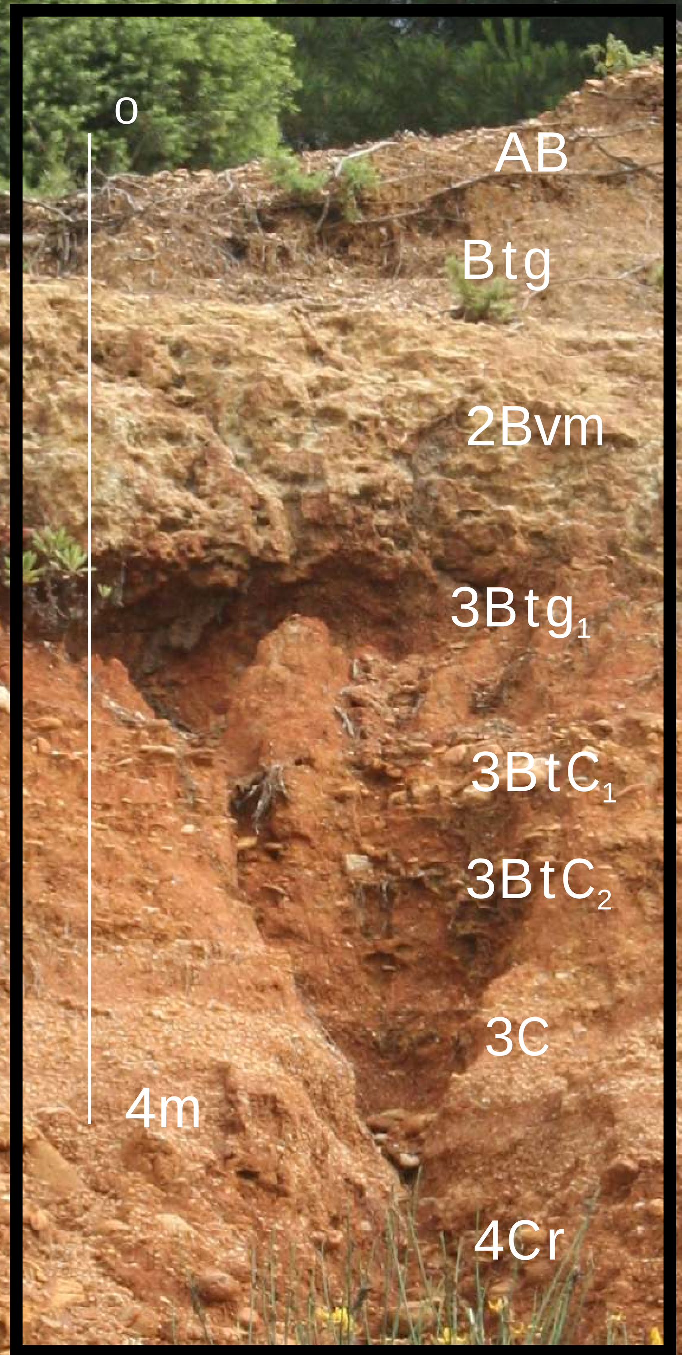
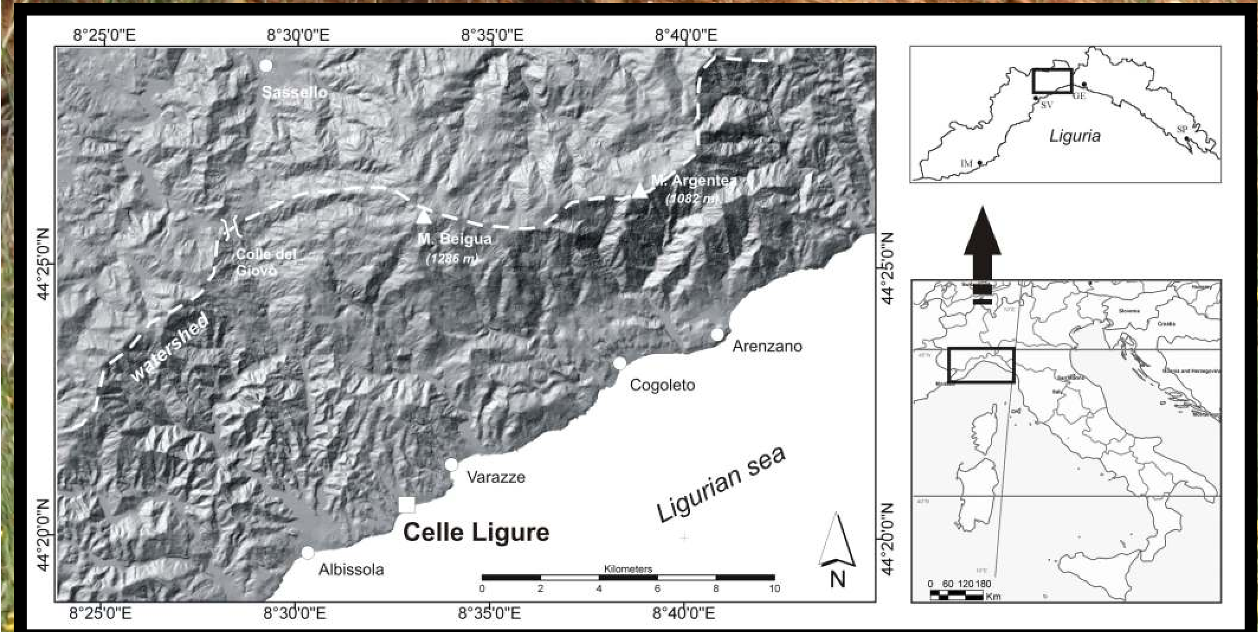
THE SOIL PROFILE was observed along the inner margin of marine terrace, which have height of 75 m above sea level near the town of Celle Ligure. The estimated age of the terrace, calculated on the base of morphological data, is **Early-Pleistocene**. On this paleosurface is possible to observe both marine and continental deposits that cover the poligenic conglomerate bedrock, which is constituted by quartz, heavy minerals (e.g. amphibole, epidote) and high percentages of lithic fragments (gneiss, serpentinite, metabasalts) .The profile involves a policyclic paleosol developed on marine sand overlain by fine colluvial layers (tab.1). Along this sector of coast, it was also possible to identify other relict surfaces higher than these terraces which are probably Pliocene in age. They are visible today as narrow sub-horizontal ridges without deposits on their top and strongly eroded.

A



THE AIM of this study is to document the evolution of costal complex paleosol developed in NW Italy during the Quaternary, and discuss the genesis of its associated petroplinthic horizon within the context of the environmental changes which should not be favourable to laterization. These events affected the soil at different levels and most of the transformation has been recorded at the microscopic scale; consequently, soil micromorphology can be considered as the most efficient approach for studying this complex paleosol. In this light, the soil forming processes imprinted the different pedosedimentary layers can be interpreted from pedological features; in fact, micromorphological interpretation of polygenetic paleosols involves the reconstruction of ordered sequences of pedogenic (and associated environmental) events from the superposition of pedofeatures.

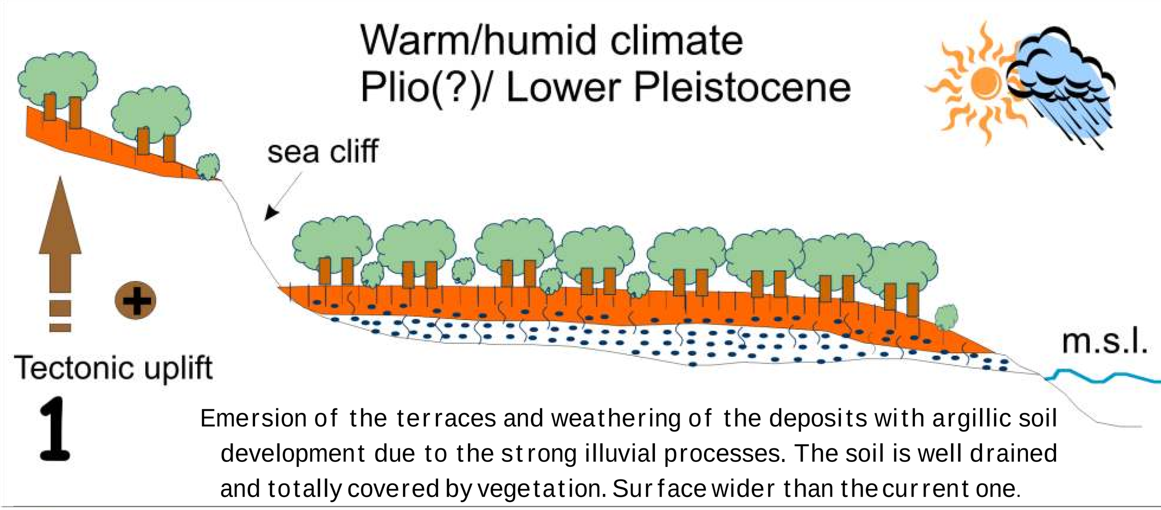


Horiz.	Particle size %			pH	$CaCO_3$ (%)	O.M. (%)	N (g/kg)	P (mg/kg P)	Cond. (µS/cm)	CEC soil (meq/100g)	Exchangeable bases (meq/100g)			
	sand	silt	clay								Ca	Mg	K	Na
AB	45.5	21.5	33	5.1	-	2.7	0.7	2	0.04	17.5	3.77	2.91	0.10	0.23
Btg	18.4	40.2	41.4	5.2	-	0.3	0.2	2	0.02	20.3	0.82	6.29	0.17	0.62
2Bvm	not sampled													
3Btg	45.6	23.5	30.9	5.3	-	0.1	0.2	3	0.02	11.8	0.99	4	0.08	0.33
3BtC1	63.4	11.6	25	5.6	-	0.5	0.2	3	0.02	13.5	1.71	5.59	0.09	0.26
3BtC2	52.7	16.3	31	6.1	-	0.1	0.2	4	0.02	16.4	3.77	6.66	0.09	0.9
3C	not sampled													

Tab.1

CONCLUSION: in this light, the plinthitisation/ferrugunization derived from iron enrichment and accumulation from an external upslope source and mainly by post-depositional precipitation of neo-formed iron and aluminia oxyhydroxides (hisingerite), deriving from the dissolution of pre-existing detrital laterite fragments. These probably derived by complete erosion of Pliocenic lateritic soils in higher landscape positions.Besides the environmental changes resulted from complex interactions between rapid uplift and climate change controlled processes, which should not have been favourable to laterization. In this case, it would be more correct to identify the petroplinthic horizon as ferricrete that as laterite body.

B

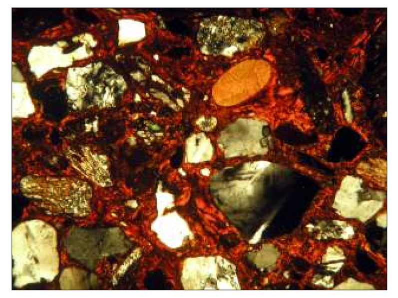


MAIN PROCESSES

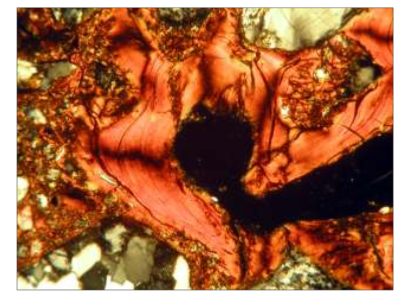
1- chemical/physical weathering
2- clay illuviation (phase 1)

RELATED PEDOFEATURES

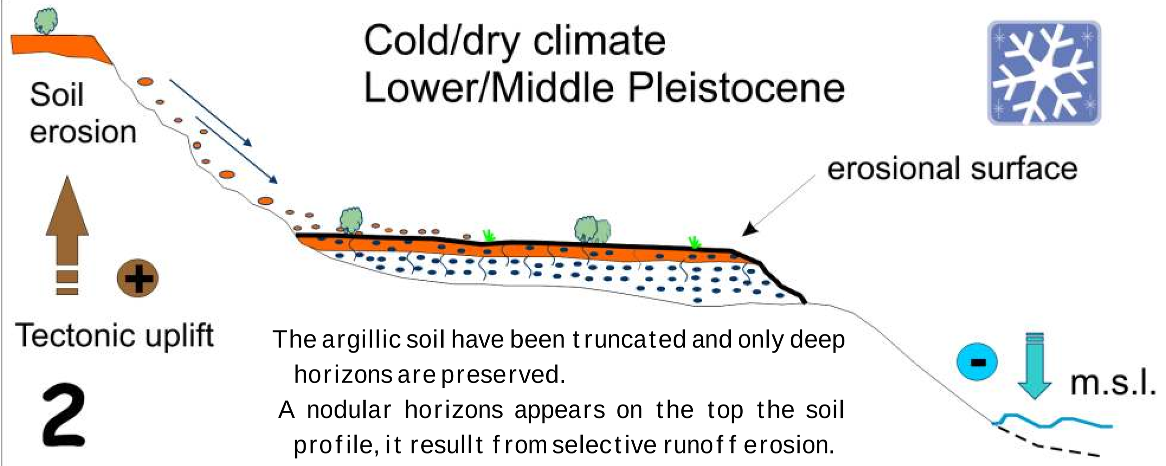
1- alteromorph and alterorelicts
2- laminated clay coatings



3Btg (40X-XPL): high degree of illuvial clay infillings.



3Btg (100X-XPL): thick laminated clay coating with sharp extinction band.

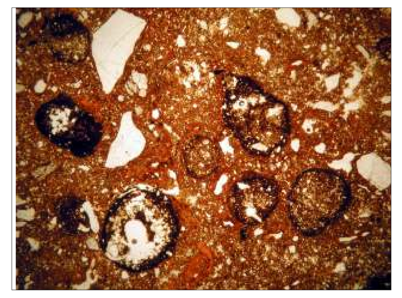


MAIN PROCESSES

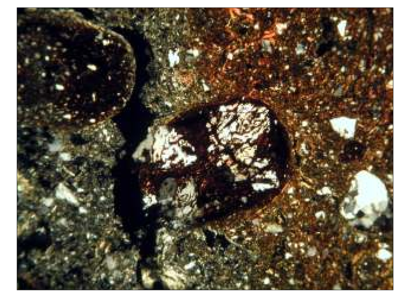
1- pre-weathered material deposition
2- selective erosion

RELATED PEDOFEATURES

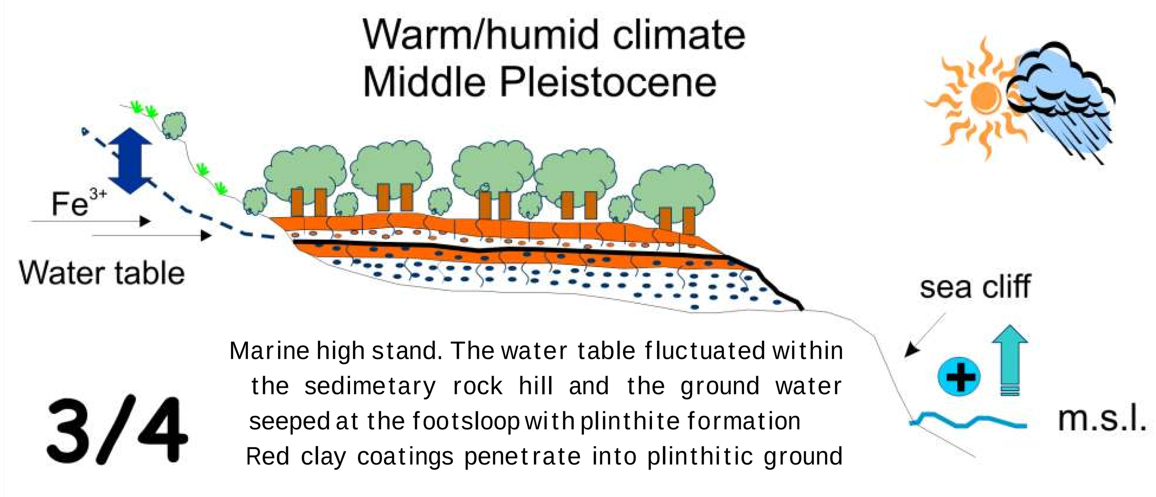
1- lithorelics
2- rounded ferrugineus nodules



2Bvm (16X-PPL): rounded Fe- nodules with sharp boundaries.



2Bvm (40X-XPL): rounded weathered lithorelict.

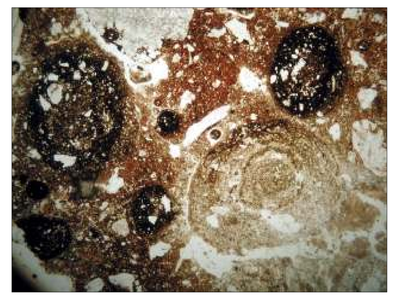


MAIN PROCESSES

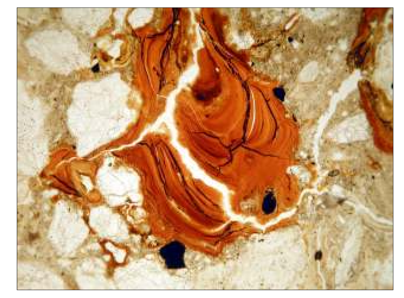
1- moderate hydromorphism (ground water saturation)
2- plinthite formation (ferrugination)
3- clay illuviation (phase 2)

RELATED PEDOFEATURES

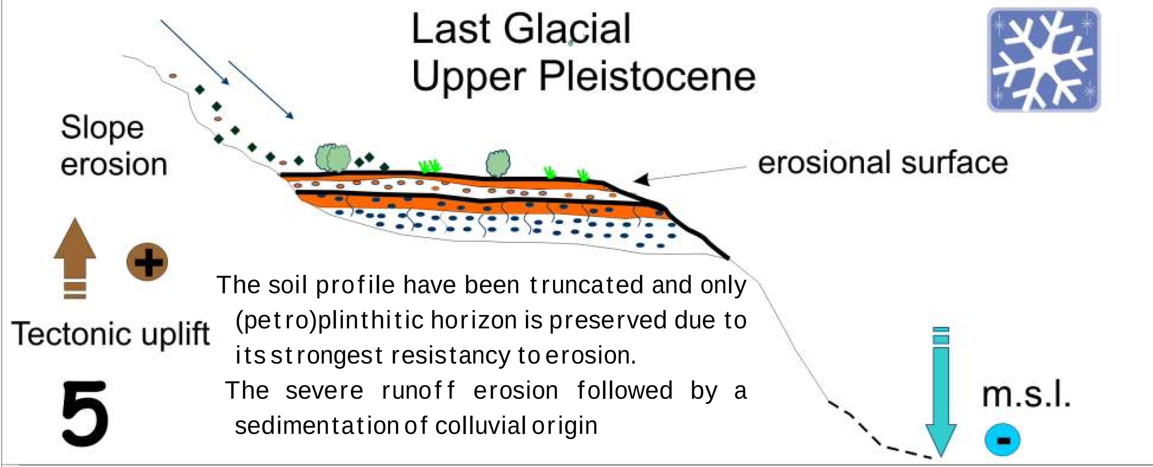
1- groundmass with Fe segregation/depletion
2- bleached Fe nodules
3- red clay coatings



2Bvm (16X-PPL): bleached Fe-nodules.



3Btg (16X-PPL): reddish clay infilling in withish groundmass.

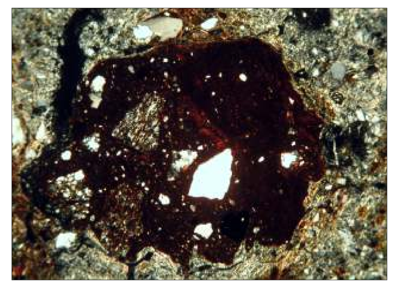


MAIN PROCESSES

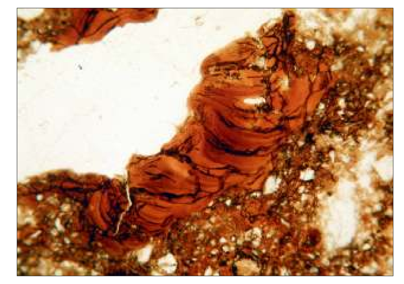
1- severe erosion
2- colluvium deposition

RELATED PEDOFEATURES

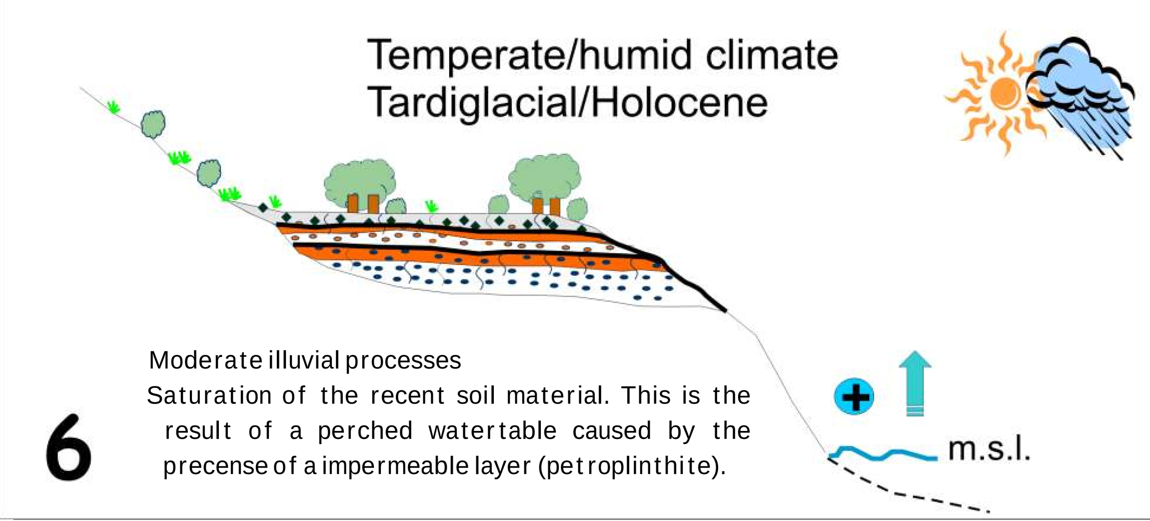
1- pedorelicts,
2- fragmented clay coatings



Btg (16X-XPL): pedorelict strongly impregneted with hematite.



2Bvm (40X-PPL): fragmented clay coating.



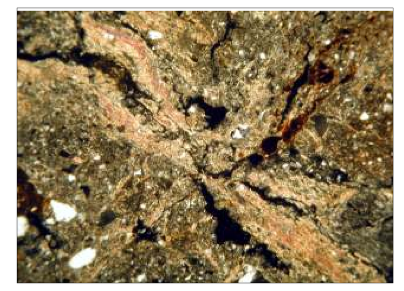
MAIN PROCESSES

1- strong hydromorphism (ground water saturation)
2- vertisolization (shrink-swell)
3- clay illuviation (phase 3)

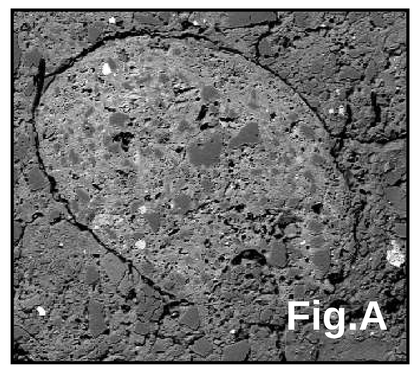
RELATED PEDOFEATURES

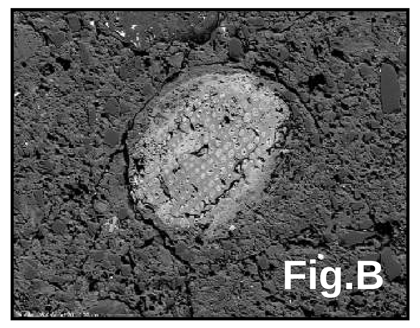
1- low chroma groundmass
2- striated b-fabric,
3- yellowish/grey clay coatings
(deformed clay coatings)

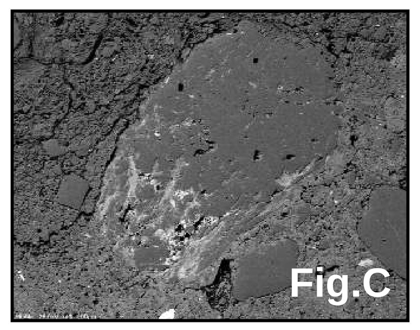
Btg (16X-XPL): striated b-fabric due to oriented clay domains.



Btg (40X-XPL): stress deformed clay coating.







PETROPLINTHITE: MAIN MICROMORPHOLOGICAL AND MINERALOGICAL FEATURES

This horizon (2Bvm) is characterised by intense iron oxide segregation in the groundmass: a dotted dark reddish brown fine material with an undifferentiated, locally speckled, b-fabric and common Fe-hypocoatings on pores and grains. The Fe-nodules are characterized by a different fabric (including small grains of chalcedony, zircon and rutile), fragments of weathered rocks, sharp boundaries and rounded shape (anorthic and disorthic nodules, Fig.A). They exhibit also various internal morphology: tipic, concentric, nucleic, geodic nodules. Some iron nodules are nucleated around well preserved charcoal fragments (Fig.B). The coarse fraction of groundmass is mainly composed of angular quarts grains and subangular quartz aggregates with intermineral weathering and comprise some severely weathered quartz grains by etching and pitting (Fig.C). XRPD results performed on each horizon evidenced the presence of quartz, albite, K-feldspar and rutile as dominant phases and a number of reflections indicating the presence of clay minerals. XRPD analysis of the fine clay fraction (< 0.2 µm) of oriented specimens indicated that the clay was composed by smectite, kaolinite and illite.