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THE POGGIO ROSSO LOCALITY CALIBRATED TO THE END-PLIOCENE AND ITS SIGNIFICANCE FOR DATING THE LATE VILLAFRANCHIAN MAMMAL FAUNAS OF THE UPPER VALDARNO, CENTRAL ITALY

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Riassunto. Il bacino continentale plio-pleistocenico del Valdarno Superiore (VS) è stato sede di un importante rinvenimento fossilifero nel settembre 1995 con il giacimento di Poggio Rosso. La fauna è ancora in fase di studio per la classificazione biocronologica, mentre la magnetostratigrafia della serie che la contiene ha fornito la sua calibrazione al crono Olduvai, che la costringe quindi ad un'età tardo-pliocenica. Dalla datazione di questo deriva la posizione temporale reciproca della fauna di Poggio Rosso rispetto a tutte le altre che costituiscono gli eventi verificatisi nei sedimenti fluvio-palustri della Successione di Montevarchi. Questa si è deposta infatti nel corso dell'intero Olduvai (e poco prima di esso) e contiene tutte le faune del Valdarno Superiore datate al Villafranchiano superiore. Perciò Poggio Rosso assume l'importante significato di avere i caratteri paleontologici, che verranno definiti nella sua fauna, già interconnessi con quelli delle altre faune dell'intera serie tardo-pliocenica, per mezzo dei rapporti cronologici stringenti forniti dalla datazione magnetostratigrafica.

Abstract. A rich deposit of mammals was discovered in September 1995 at Poggio Rosso, the hill-top of the Matassino clay pit, in the Upper Valdarno Basin, 30 m above another deposit whose local fauna was assembled 30 years earlier. This latter provided the Matassino Locality, assigned to the beginning of the late Villafranchian Mammal Neogene age on the basis of its affinity with the Olivola faunal unit, which was also taken to represent the earliest assemblage in the Pleistocene. The paleomagnetic record in the short section across the Matassino Locality revealed the Olduvai chron, which was imprinted also in the fossil-bearing stratum of Poggio Rosso, so constraining both their ages to the latest Pliocene. The Poggio Rosso fauna, yet to be paleontologically determined, and the other late Villafranchian faunas collected in the Upper Valdarno from the Montevarchi complex fit a similar time span. Therefore, their magnetostratigraphically calibrated ages provide the time constraints for the biochronological relationships between faunas which can be tuned to several tie points for numerically evaluating their diversification steps during the whole Olduvai chron and shortly out of it.

Introduction.

The Pliocene of the Italian peninsula is largely made of marine deposits where the Pleistocene boundary was searched for one century, after it had been fixed by Gignoux with the first appearence of *Arctica islandica* in the Mediterranean, but this criterion was found to be of difficult application and was finally fixed at the Vrica stratotype (Van Couvering 1997). In the meantime, the continental sediments firstly deposited in the Apennine intermontane basins during the second half of the middle Pliocene when the mountain belt started to uplift and displace in its present NW-SE setting. The rich literature for the Northern Apennines was reviewed by Abbate et al. (1970), and an updated interpretation of the basinal features was given by Martini & Sagri (1993). The earliest sediments from the Northern Apennine continental basins are exposed in the Upper Valdarno (UV) (Fig. 1), and the faunal remains there assembled were ordered in the biochronologic Villafranchian sequence of the Mammal Neogene Age classification (Azzaroli 1977; Azzaroli et al. 1986). It may be pointed out that the Plio/Pleistocene boundary does not make any characteristical change in continental faunas; much more significant are two faunal revolutions, one at approximately the Gauss/Matuyama magnetochron boundary and the second around the Jaramillo (Azzaroli 1983; 1995).

The oldest sequence is mainly exposed in the Santa Barbara clay pit, whose thick lacustrine sediments were largely exploited for their lignite-bearing seams. The beginning of the continental sedimentation was there dated as 3.3 Ma (Albianelli et al. 1997) in the Mammoth event of the Gauss chron. At nearly 3.1 Ma, during the Keana event, it moved to a lacustrine deposition and lasted through most of the upper Gauss until 2.64 Ma (Napoleone & Albianelli 1998) when the sandy facies filled the lake. Thereafter, a short sequence deposited during the tectonic activity, which lasted until

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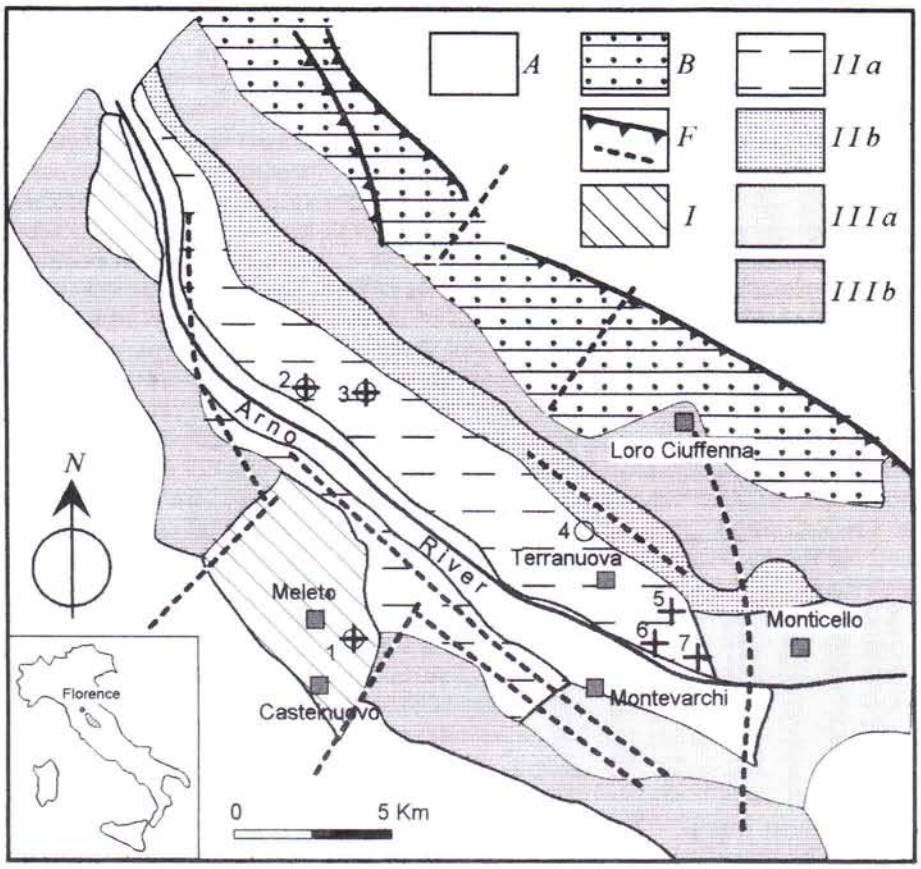

Fig. 1 - The Upper Valdarno geologic setting, with its main features NW-SE aligned in the typical Apennine trend (Modified from Lazzeri & Azzaroli 1975, quoted in Azzaroli 1977). A: Recent alluvium; B: Bedrock; F: Faults; I: First sedimentary sequence; IIa: Second sedimentary sequence - lacustrine deposits; IIb: Second sedimentary sequence - fan-delta deposits; IIIa: Third sedimentary sequence - fluvial sediments; IIIb: Third sedimentary sequence - alluvial-fan sediments. 1-7: Sampled sections, 1) Santa Barbara pit, 2) Matassino pit, 3) Faella pit, 4) Casa Frata Locality, 5) Case Bacchi section, 6) Levane section, 7) Tasso-tunnel section. Crosses indicate the paleomagnetic sampling sites, Circles the Fossil sites.

some time between the end of R,union (2.24 Ma) and more than 50 ky before the Olduvai (1.95 Ma), when the exposed palustrine fan-delta deposition recommenced. The sequence in our area of interest (Fig. 2) spans through the latest Pliocene, from 2.0 Ma to the beginning of the Quaternary.

The calibration of the Pliocene continental sedimentation in the UV dates also its faunal record relative to that of the Italian peninsula. The Triversa Faunal Unit (F.U.) represents the base of the land mammalian sequence synthesized in the Villafranchian Stage (Azzaroli 1977; 1983), which was typified by Villafranca localities (near Asti, Piemonte, North-Western Italy). In the UV, the Triversa F.U. is represented by the Castelnuovo dei Sabbioni local fauna (l. f.) mostly collected in the lignite seam which was above reported as shortly older than 3.0 Ma from its magnetostratigraphy.

The next UV fossil findings are in the post-tectonic deposits. In the gap, the record of the Montopoli F.U. found in the Lower Valdarno at the boundary of the middle and late Pliocene (Lindsay et al. 1980) is missing in the UV, and the following Olivola F.U., which was determined in the Valdimagra basin in North-western Toscana, is missing too. Then, the first new faunal assemblage was there the well representative Matassino l.f., the sole calibrated one (Torre et al., 1993) before the nearby Faella magnetostratigraphic section was designated to represent the type section for the last 200 ky before the Pleistocene (Albianelli et al. 2000). The specimens of the Faella old collection in the Natural History Museum of Firenze University (NHMFU) were positioned in the section from the catalogue information, and together with new findings dated to last most of the Olduvai chron C2n and shortly before it (Cioppi & Napoleone 2001b). Also the Matassino section showed an Olduvai age, its fossil site (in the mid section of Fig. 3) being 10 m above the onset of the magnetozone at the ground level, while the Tasso F.U., finally originating in the UV and assembled more than a century ago from several localities of unknown position, is of late Villafranchian but posterior to the Olivola F.U. and not calibrated.

The Poggio Rosso Locality is on top of the Matassino clay pit sequence; together with the Matassino l. f. provides a record of the late Villafranchian that requires a correlation with other UV equivalent faunas, by means of calibrated sections, such as that of Faella.

Site location and history of recovery.

The present clay pit of the Matassino area (Fig. 3) serves the Solava brick factory since the early 1950s. The distinctive Matassino l. f. was established in the mid 1960s by assembling the Matassino deposit and its two partial skeletons of young elephants together with other scattered finds from various sites nearby. The overlying Poggio Rosso site is located on the map of Fig. 2, between that of Matassino and the Faella small town; also the other nearby sites are represented by the fossil

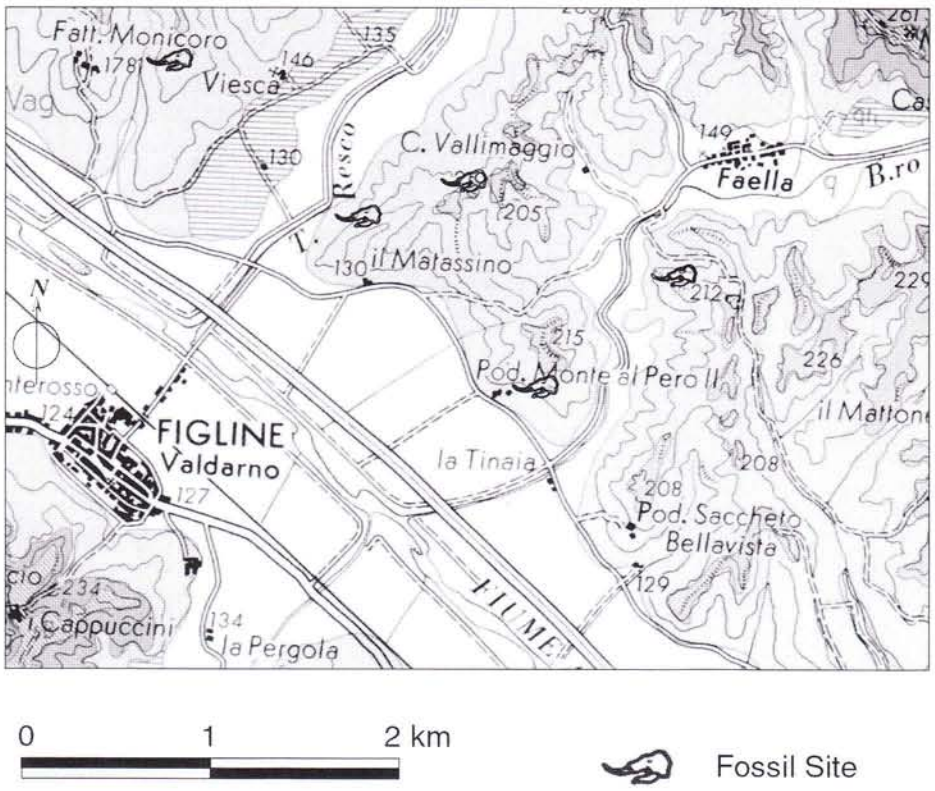

Fig. 2 - Topographic map of the area where the closest localities to Poggio Rosso are (marked by the symbol). The Matassino site is close to the Resco creek, to the North-east of the main Figline Valdarno town; the hilltop (poggio) of the clay pit is to the East, at 205 m altitude, and contains the Poggio Rosso Locality. Further to the East, the house labeled C. Vallimaggio, between the fossil symbol and the Faella village, is the distance reference of 1 km from the latter. The Faella fossil site is South-west of the village, in the pit section reaching 212 m altitude. In the next hill farther to the South-west reaching 215 m altitude, Monte al Pero, Nesti's *Rhinoceros* was found at two thirds of the ca. 75 m high mound.

symbol, while the outcrop of the Poggio Rosso recovered material is shown in Fig. 4. Its elevation is 178 m above the sea level, and 44 m above the Solava factory ground-level; in the Section of Geology and Paleontology of the NHMFU it is recorded on the GEF automated catalogue (Cioppi et al. 1996) as the vertebrate fossil locality No. 189, while the No. 29 is for Matassino.

The fossil remains were found at Poggio Rosso during the excavation of new steps in the upper silt and clay of the Matassino pit; on the hill-top (poggio) the oxidation of close paleosol levels showed a marked reddish (rosso) colour. The initial evaluation of the site was made by one of us (M. Mazzini) on personal informations by an amateur collector (M. Martinelli) who noticed a pebbly inclusion (then revealed to be teeth of a rhinoceros maxillary) in the sandy channel section bordered by the bluish sandy-silts of the new cut. The Museum immediately entered into a mutual agreement with the Solava management to interrupt the excavations. Orientation of the fossil site, 5 m long and 1-2 m wide, was marked and photographs were taken to map the position of the deposit. Recovery work began on September 25, 1995 and concluded on October 7, 1995. About 300 specimens were collected by the Solava workers in the removed material during the ongoing excavations and almost 800 during the fossil recovery, besides those maintained in blocks (Fig. 6), casted in an expanded polyurhetane resine, and brought to the NHMFU laboratory for restoration. Fossils are represented by skulls, by partially disarticulated limbs and few isolated bones. Many bones show traces of hyaena bits.

Geology.

An updated study of the UV sedimentary phases was reported by Sagri et al. (1994), in the general trend of the extensional basins produced along the Apennine belt (Martini & Sagri 1993), while a detailed reconstruction of the Montevarchi sequence was made by Magi (1999). Three units are grouped in this second complex of the basin fill after a long interruption (from 2.64 Ma, shortly before the end of the Gauss chron at 2.58 Ma, to more than 50 ky before the onset of the Olduvai at 1.95 Ma) during the phase of tectonic activity. It accompanied a major uplift and produced a noticeable tilting in the lacustrine clay sequence of the Castelnuovo Succession which unconformably lies underneath.

The Montevarchi sequence is best represented in the outcrop of the Faella clay pit with fresh exposures to allow for detailed surveying of the sedimentary structures, namely (from the bottom) the Terranuova silt, Ascione clay, and Oreno sand, separated by minor interruptions of paleosols, more frequently repeated in the upper levels. To that section one may refer for more details (Albianelli et al. 2000).

Back to the Matassino pit, the clay exploitement for the brick factory began in the basal silt member, which was well exposed in a large front, for a thickness of ca. 20 m (Fig. 3). These walls were sampled for magnetostratigraphy in the outcrop where the Matassino fauna was recovered (Torre et al. 1993). On mid 1990s the operations moved to the top of the sequence, where the upper Ascione clay and lower Oreno sand were cut in vertical steps. The discovery of the rich locality was followed by three significant findings on the same out-

Fig. 3 - The area of Matassino and its quarry. The clay wall yielded the main Matassino deposit almost midway of the 20 m thick sequence. The cliff continues eastwards to the right with a covered sequence of almost 30 m and then the Poggio Rosso section is exposed (in next Fig. 4).

crop (Napoleone et al. 2001b). The general assessment of these units in the Montevarchi Succession, was averaged from several outcrops as a 70-80 m thick sequence representing 20-25 m of the not fully outcropping Terranuova silt, 25-30 m of Ascione clay, 20-25 m of Oreno sand. At the Matassino pit the designated units crop out for a limited extent: the Matassino faunal deposit was embedded in the Terranuova silt, and the Poggio Rosso one near the transition from the upper beds of Ascione to the basal Oreno (Fig. 4). The simplified log of the latter section gives the lithofacies characterizing the transition from Ascione to Oreno, while its marked boundary is only indicative.

Paleomagnetism.

The 22 m thick outcrop of Poggio Rosso was repeatedly sampled for paleomagnetic analysis, after the reconnaissance survey was carried out soon after the recovery of the fauna. A closer spaced sampling was extended in early 1996 to the uppermost sand. Efforts to measure also the coarser fraction of the sandy top section led to increase the total length and be sure that the short polarity intervals found for the end Olduvai in the fresh cuts of the composite Faella section reported by Albianelli et al. (2000), could not be missed. The active exploitement at the base of the pit produced more cuts on mid 1997, and a minor magnetostratigraphic extension was added to the sequence. Last sampling was done at highest rate soon after the complete skeleton of a rhinoceros was recovered in July 1999 in the uppermost layers of the outcrop, while remains of the deer and other artiodactyls were found just above the Poggio Rosso site. The aim of last sampling was to apply in this short time series with only one polarity the cyclostratigraphic processing of the magnetic signature, in order to reach a very high resolutions in the range of few ky, as it was done in the mid Pliocene long lacustrine sequence (Napoleone & Albianelli 1998).

The horizons sampled along the section of Fig. 4 were at an average spacing of 30 cm for magnetostratigraphy, while last sampling for cyclostratigraphy was made at 10 cm constant spacing. All samples for magnetostratigraphy were measured with more than one specimen, but their week intensities of the natural remanent magnetization (NRM) (mostly ranging 10-5 A/m with peaks up to 3.4 x 10-3 A/m) often gave poor results. Also more than one specimen was used for demagnetization treatments, either thermal or with alternative current (AC) applied fields, while thereafter they were made routinely with the thermal demagnetization for the whole series.

The response to the rock magnetic tests indicated a fairly good behavior depending upon the fine grain magnetite as the main carrier of the magnetic signal, though accompanied by some sulfide compounds. These were enhanced at temperatures above 300-350 °C when transformed to a new mineral phase, as shown by the magnetic behavior in other units of the UV filling and very effectively in the lignite seam of the Castelnuovo Succession and clay levels above it (Albianelli et al. 1997). In Fig. 5, the diagram for the demagnetization steps of the NRM is reported for the univectorial decay of the declination and inclination towards the origin in the Zijderveld diagram. All measurements which fitted the good-behaved demagnetization procedures where considered for assigning the polarity directions. The sampled outcrop yielded only one normal polarity, referred to the Olduvai chron because this magnetostratigraphic age could be derived from calibration with the Faella facing section and its lithostratigraphic assessment around the Pliocene-Pleistocene boundary (Albianelli et al., 2000; Cioppi & Napoleone 2001).

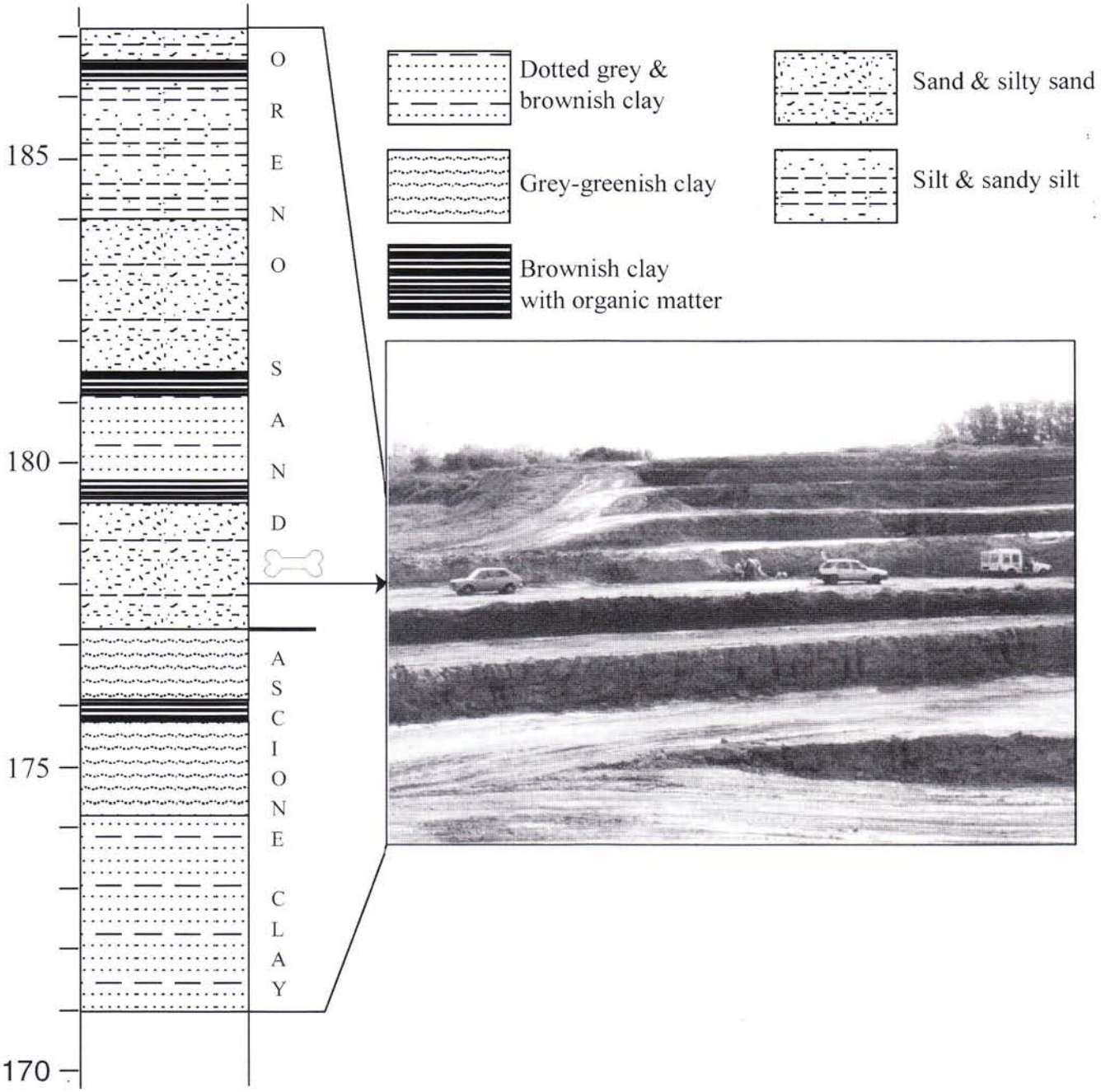

Fig. 4 - The Poggio Rosso section seen from the South-west during the excavations. On the left hand side, the simplified lithostratigraphic log is shown and the arrow indicates the level of the fossil site. The boundary is marked with an allowance of few meters: above it, the Oreno sand continues from the uppermost three steps farther in the removed bank, while downward the Ascione clay is still covered.

The first use of this determination was made for reconsidering the Matassino section at the base of the sequence quarried in the Matassino clay pit. Its faunal assemblage was reported to be of close affinity with the Olivola F.U., which was assigned to make the base of the late Villafranchian Stage (Azzaroli, 1977). The higher stratigraphic position of the Poggio Rosso Locality was marked by a plain Olduvai polarity still not at the split end of the chron, and therefore it would be younger than the Matassino fauna, which actually is shortly later than the Olduvai onset (Cioppi & Napoleone 2001a,b). More discussion will be reported below, but one may notice that Azzaroli (1998) based his biochronologic statements for dating the UV porcupine on this magnetostratigraphic framework to correlate its late Villafranchian age with various occurrences in the Mediterranean area.

Fauna.

The vertebrate fossils recovered from the Poggio Rosso deposit represent the most abundant faunal assemblage ever acquired by the NHMFU. Also the number of species seems to be the highest one (Torre et

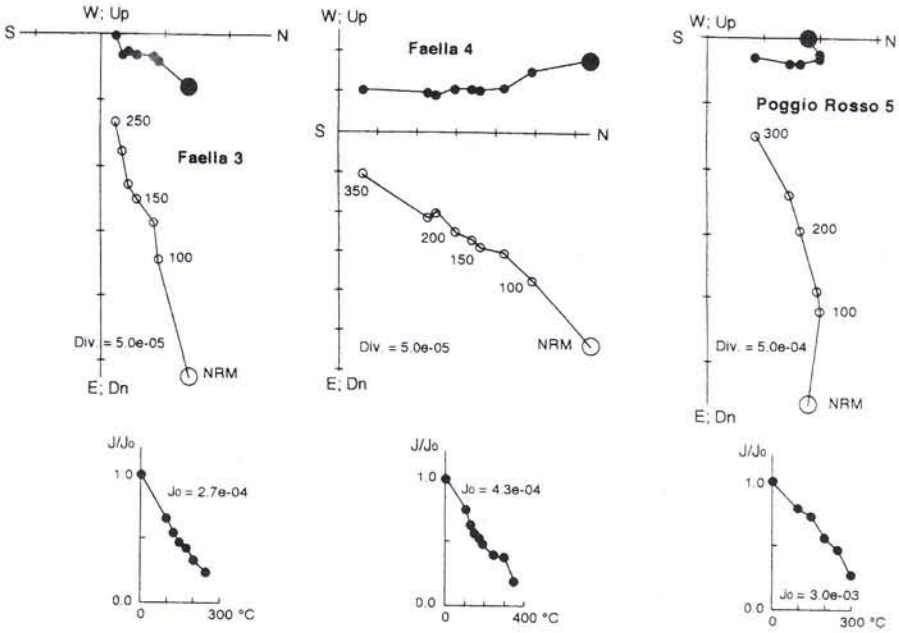

Fig. 5 - Example of the rock magnetic behavior of the Faella and Poggio Rosso silt under the thermal demagnetization; the lower diagram of each site reports the demagnetization steps vs. temperature, while in the vector component plots the open circles are for inclination, and filled circles for declination.

al., in preparation). The visually identified taxa, either looking to the remains in their natural disposition (Fig. 6), or in the collected blocks were listed in 1997 by A. Azzaroli and P. Mazza for the Museum temporary exhibit, reproduced in Table 1, and reported by Mazzini et al. (2000) as the most typical species in the UV fauna of the late Villafranchian age. In fact, while the official definition will be reported when the study of the bones will be ready, the cataloguing of about half of the more than one thousand specimens is ready, after a preliminary comparison with the specimens of the research collections and related literature. Although descriptions of the faunal material are not provided here, it is noteworthy to say that magnetostratigraphy of the correlatable series within the Montevarchi Succession represents a constraint to the faunas retrieved in the same magnetostratigraphic level and few hundred meters apart, which thus belong to the same biochronological units. One such tests was carried out on the rhinoceros described by Nesti in 1811, and located in the outskirt of the same Matassino hill (Napoleone et al. 2001a). Also its dating was done by reference to the Faella magnetostratigraphic type section, the position being precisely reported by Nesti. In conclusion, the fauna of Poggio Rosso, still to be defined, is preceded by the Matassino fauna, whose paleontological determinations remained however at the preliminary stage, and both contain similar assemblages retrieved from magnetostratigraphic levels precisely dated within the Olduvai age.

Order Proboscidea
Family Elephantidae
Archidiskodon meridionalis
Order Perissodactyla
Family Equidae
Equus stenonis
Equus stehlini
Stephanorhinus etruscus
Order Artiodactyla
Family Bovidae
Leptobos etruscus
Family Cervidae
Eucladoceros dicranios
Pseudodama nestii
Family Suidae
Sus strozzii
Order Carnivora
Family Hyaenidae
Pachycrocuta brevirostris
Family Canidae
Canis arnensis
Family Ursidae
Ursus etruscus
Order Rodentia
Family Heteromyidae
Castor plicidens

Tab. 1 - List of the Poggio Rosso fossil mammals, identified by Azzaroli & Mazza, 1997, for their temporary exhibit, reported by Mazzini et al. (2000).

Age.

The biochronological age of the Poggio Rosso fauna is late Villafranchian, based on the currently known stratigraphic ranges which were assumed for the

UV faunas since the recognition made by Azzaroli (1977). All faunas from the Montevarchi series are younger than the Olivola Faunal Unit because they missed several species which disappeared (for instance, *Proputorius olivolanus* -now *Enhydrictis ardea*-, *Nemorhoedus philisi, Acynonyx pardinensis, Felis lunensis, Lycyaena -now Euryboas- lunensis*), and marked in contrast the new coming of *Canis arnensis, Leptobos vallisarni*, *Equus stehlini*, and cervids also showed some changes, although moderate (Azzaroli 1992).

The magnetostratigraphic data instead relate to the geologic features which are given by the detailed lithostratigraphy of the Montevarchi units, and revealed an Olduvai magnetic signature for almost all of the exposed sequence. Therefore, the constraints on the Poggio Rosso stratigraphic range (and other sites in the sequence) lead to a narrow band for dating. Most of the taxa, though, allow to exclude this assemblage from the Olivola and Tasso Faunal Units and possibly lie between

Fig. 6 - The recovery of the Poggio Rosso fauna on 1995: part of the deposit is ready to be casted in the polyurhetane for removal.

them, as it was already suggested for the Matassino fauna (Gliozzi et al. 1997). The problems arising from magnetochronology on the present asset of the UV faunal events were discussed by Cioppi & Napoleone (2001a,b). Case histories were reappraised from the old collections, for which a stratigraphic record was reported in the catalogue, and satisfactory age resolutions attained, such as for the already mentioned rhinoceros recovered in 1811 and now dated 1.830 ± 0.015 Ma (Napoleone et al. 2001a), from calibration to the Faella section.

At present, the Poggio Rosso fauna allowed only for a relatively vague biochronologic definition; and it was not really because most of the identifications are provisional, or tentative to the genus level, but mainly as such late Villafranchian species may encompass an undefined range which needs a calibration. The precipuous ones, *Canis arnensis, Equus stehlini* and *Leptobos vallisarni*, indicate a newly diversified assemblage after the Olivola fauna, but are also well established in the Matassino and Faella faunas where they occupy some different levels, and thus different ages in the Olduvai chron to which all of them do belong, and calculated in a range of nearly 200 ky (Cioppi & Napoleone 2001a).

Preliminary magnetic analyses on the Poggio Rosso section provided one normal polarity; but their results remained unpublished because they did not allow for that fauna to fit the previous calibration of the Matassino fauna in the latest Olduvai. The sampling in the former section spanned 22 m, that is less than one third of the whole Matassino pit sequence, and was constrained to an Olduvai age independently from the biochronologic data of the present Poggio Rosso fauna. The adjacent sequence of the 1811 Rhinoceros extends almost the whole length of the Matassino pit including Poggio Rosso, and is magnetized with the normal polarity of the lower Olduvai. The occurrence of the upper Olduvai chron as split in two short reversals, such as shown in the Plio/Pleistocene boundary stratotype (Zijderveld et al. 1991), puts the Poggio Rosso site in a sequence entirely deposited before this Olduvai bipartite interval lasting 45 ky (Fig. 7). The cyclostratigraphic reconstruction of the continuous magnetic changes through the section led to define a 70 ky duration for its accumulation (Napoleone et al. 2001b)

Discussion and Conclusions.

The fresh outcrops in the Faella pit became available only recently for paleomagnetic sampling and sedimentologic detailed surveys, and its sequence resulted equivalent to that of Matassino, as both recorded the Olduvai base occurring shortly above the ground level (Albianelli et al. 2000). But the new recoveries which there occurred are located at different stratigraphic distance from this marker. At Faella, the deer antler and horse mandible were recovered in the abandoned walls ca. 15 m below the base of the Olduvai, and their magnetostratigraphic ages were 1.980 and 1.990 ± 0.002 Ma.

These lavels are the base of the magnetic type sequence whose Olduvai time span (1.95-1.77 Ma) calibrates also the fossil specimens of the old collection, positioned in the magnetostratigraphic section as to yield the ages of 1.943 Ma, 1.870 Ma, and 1.820 Ma, while the last year finds date the range 1.990 Ma through 1.875 Ma (Cioppi & Napoleone 2001). At Matassino, in contrast, the mirroring exposure which duplicates the Faella sequence starts with the beginning of the Olduvai, and 10 m above it the Matassino l.f. was collected, but the new fauna recovered in 1995 at Poggio Rosso is close to the end of the magnetozone (dated 1.815 Ma in the stratotype). Therefore, the recent finds confirm that the Montevarchi sequence mostly deposited during the Olduvai and extended downwards beyond it. Moreover, this fauna played also the role of driving more attention to the asset of the UV which was defined by its magnetochronology, thus focusing it to the critical transition from Pliocene to the Pleistocene. Such a role can be summarized by the following points.

1) The Poggio Rosso Locality proved the need to revise the ages of the late Villafranchian faunas, because the biochronologic dating could not resolve their position between the Olivola and Tasso mammal units, of unknown duration without the magnetostratigraphy of the Montevarchi Succession. This was established in the Faella section, which allowed to date the Museum fossil collection grouped in the Faella assemblage as spanning 170 ky (Cioppi & Napoleone 2001), and became the type section to which the local faunas from other sites could be referred. Each site formed during that time span, could be assigned an age with a few ky resolution, and any biochronological change be monitored within a narrow margin by means of the magnetostratigraphic calibration.

2) From the previous point it could be proved that the Matassino fauna, assigned to follow in the early Pleistocene the biochronologic position of the Olivola F.U., was misdated when its short section was calibrated to the latest Olduvai. Now the Faella continuous section has shown the same Olduvai onset as Matassino at its base, but also the full extent of it. Thence, the recognition of the actual stratigraphic position of the Poggio Rosso find as directly overlying the Matassino deposit was made possible by correlation of both adjacent sequences of Matassino and Monte al Pero, since they share the same Olduvai record and the magnetostratigraphic calibration to the Faella type section (Napoleone et al. 2001b). Before this result, the biochronological definition of the Poggio Rosso Locality was longly delayed by the conditions put on the Matassino Locality, until it remained dated to the end of the Olduvai. The solution is presently related to the recognized Pleistocene boundary as "just before the end of the Olduvai chron" and this latter found to be split in two short reversals which yield a resolution better than

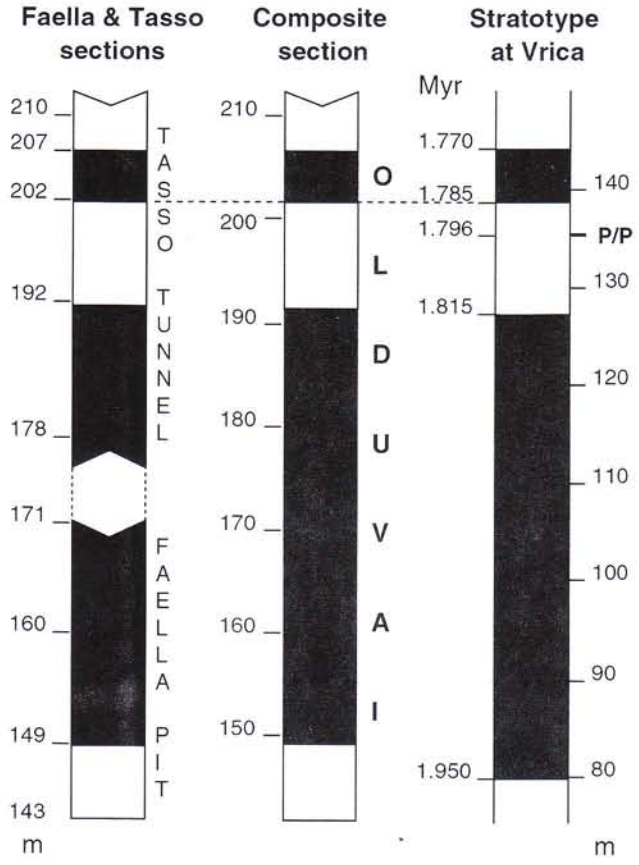

Fig. 7 - Late stratigraphic units of the Upper Valdarno fill as defined by Azzaroli (1977), and modified by Magi et al. (1992), and Martini & Sagri (1993); the magnetochronologic column, referred to Berggren's et al. (1995) time scale, is by Albianelli et al. (1997) for the Gauss and early Matuyama, and by Albianelli et al. (2000) for the Olduvai.

few thounsand years (Van Couvering 1997). All this new asset will remove the statement, established by Azzaroli (1977) and successively stressed (Azzaroli 1983; 1992; Azzaroli et al. 1986), on the late Villafranchian (with its Olivola F.U.) commencing with the new Pleistocene biostratigraphic age. Such a statement is indeed still maintained in present-day studies, in their own quoted magnetostratigraphic references (Abbazzi et al. 1995; Gliozzi et al. 1997; Masini et al. 1998), not recognizing yet the Pliocene age of the Olduvai chron.

3) It took five years to collect field evidences for a variety of lithologies with fairly good rock magnetic properties which allowed to attain the present magnetostratigraphical resolutions (Napoleone & Albianelli, in preparation). It was possible to prove that the Olivola F.U. dated to a Pleistocene age (Azzaroli 1977) and its aforesaid confirmation (Gliozzi et al. 1997), resulting from a long-lasting tendency to make younger all late Villafranchian faunas, were misleading for the local faunas belonging to the Montevarchi Succession of UV. They were all biochronologically subsequent to the Olivola mammal age, but their presently calibrated ages, spanning from 1.980 and 1.990 ± 0.002 Ma of the low-

ermost in the series and last acquired specimens of April 1999 and January 2000 to nearly the boundary age of the oldest ones in the Museum collections, prevent to assign them a date of early Pleistocene, still reported though in the catalogue. These ages make them to include the most ancient finds in the Montevarchi Succession, as its appearence is 200 ky before the beginning of the Quaternary, well down in the late Pliocene. This first event in the late Villafranchian of the UV actually followed by 1 my the small faunal deposit of the early Villafranchian, collected during the exploitement of the lignite at Castelnuovo dei Sabbioni. While the faunal diversity was there significant, only the high resolution presently attained by magnetostratigraphy for the Olduvai time interval will lead to date the smallest recognizable changes in the late Villafranchian local faunas.

4) The firmly confined age of the Poggio Rosso Locality in the magnetostratigraphic time scale, now established by the Olduvai assessment of the Faella type section, and based on both the direct measurements of its short section of one normal polarity segment and the indirect correlation with the Faella type section through the Monte al Pero section, imposes the biochronologic dating to fit the biostratigraphic one. The latter site was in fact calibrated by the Faella type section, while the top of the Poggio Rosso section contains the lately found rhinoceros, as a tie point which correlates with that of Nesti at Monte al Pero dated 1.830 ñ 0.015 Ma (Napoleone et al. 2001), that is before the end of the Pliocene. As already said, the other tie point for the Matassino and Faella sections was the Olduvai onset (1.95 Ma) to which their faunas were calibrated, the Matassino l.f. shortly younger than it at ca. 1.915 Ma and that of Faella 40 ky older (1.990 Ma). Consequently, these faunas, being considered younger than the Olivola F.U., bring a tight constraint to date this latter, which ought to be pre-Olduvai and quite farther back from the Pleistocene boundary age.

5) The role of the Poggio Rosso Locality was also decisive for applying independent ways to reach high resolutions, even when the only available means are in the magnetic record, and without a polarity sequence. The only one normal polarity and the shortness of the time series was an extreme case for applying the cyclostratigraphic treatment of the magnetic signature in the lacustrine deposits of the Apennine basins (Napoleone & Albianelli 1998). The correlation with the Faella reference sequence and its fundamental cyclostratigraphy led to attain a high-resolution in the short periods of the Milankovitch cycles for dating the four superimposed fossil sites in the Poggio Rosso section (Napoleone et al., 2001,b). The whole sequence spans 70 ky, having a tie point in the 1999 Rhinoceros site already correlated with that of 1811 at Monte al Pero (Napoleone et al. 2001a); the accuracy for their correlation is better than ± 5 ky, and the age difference between the extreme sites is 45 ky, that of Poggio Rosso being 1.870 Ma.

6) One more interest was triggered by the discovery of the Poggio Rosso Locality, as it imposed a more detailed study of the Montevarchi units by surveying the newly opened sections, and improvements for the GEF software of the Museum catalogue (Cioppi, in preparation). The former recognitions offered the opportunity to locate several faunas collected in sites across the Olduvai magnetochron and the Pleistocene boundary with a firm constraint, while the catalogue updating will be better devoted to enhance the time relationships between the UV mammal faunas and more in general of the Villafranchian vertebrate collections in the NHMFU. In particular, the UV collections in the Museum have already been reappraised, together with the search for new fossil deposits. Specially having in mind the long history of the Museum with its most and best collections missing the age references, also the dating of "museal outcrops" represent a very important goal: the old collections become the newly "discovered" localities from the catalogue informations, and dated in stratigraphic succession within few ky accuracy.

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