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# Quaternary Mammals from Central-Western Argentina in the Stratigraphic Context of Southern South America

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**Abstract:** This is an updated contribution to the Quaternary geology and paleontology from central-western Argentina, focused on San Luis Province. It is mostly based on unpublished data; only some fossils had previously been briefly mentioned in broader faunal contexts. The fossil-bearing sediments correspond to eolian and alluvial environments of moderate energy, dominated by sands and sandy silts. They overlie high-energy fluvial cycles and underlie edaphic horizons. They have a wide distribution, and several radiocarbon dates allow their regional correlation. Stratigraphic sequences with the precise origin of fossils allow for the improvement of lithostratigraphic and faunal correlations with the Pampean Region (central and east Argentina; La Pampa and Buenos Aires provinces), where Pleistocene assemblages are better known, but also with central-western (Cuyo Region), northwestern, and northeastern Argentina. Faunal remains correspond to large mammals, represented by xenarthrans (Cingulata and Tardigrada), macraucheniids (Litopterna), gomphotheres (Proboscidea), and equids (Perissodactyla), a typical Pleistocene mixture of native (xenarthrans and litopterns) and immigrant mammals.

**Keywords:** stratigraphy; macromammals; Pleistocene; Lower Holocene; San Luis Province; Pampean Region



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## 1. Introduction

Quaternary deposits form an extensively distributed cover in San Luis Province, central Argentina (Figure 1). They are composed of piedmont deposits, alluvial and eolian plains, in lacustrine and fluvial environments, corresponding to clastic sediments, including levels with an exceptionally high concentration of chemical precipitations (carbonates, sulfates, chlorides). Also, the sand-sized textures are dominant, with variable percentages of silt and clays, while gravels occur in channels and piedmont deposits. The outcrops present particular characteristics in each area, and paleosols can be well-developed [1]. Although fossils (mammals, gastropods, diatoms, and pollen) have been known in San Luis since the 19th century, detailed studies are scarce, especially concerning Quaternary remains [2], in contrast to the better-known Neogene faunas [3]. In addition, Quaternary fossil findings sometimes lack geographic and stratigraphic data (e.g., [4]). In contrast, studies on the geomorphology, sedimentology, and chronology of San Luis Quaternary sequences have grown significantly in recent years (e.g., [5,6], among others), and many of these contributions included references to fossils.

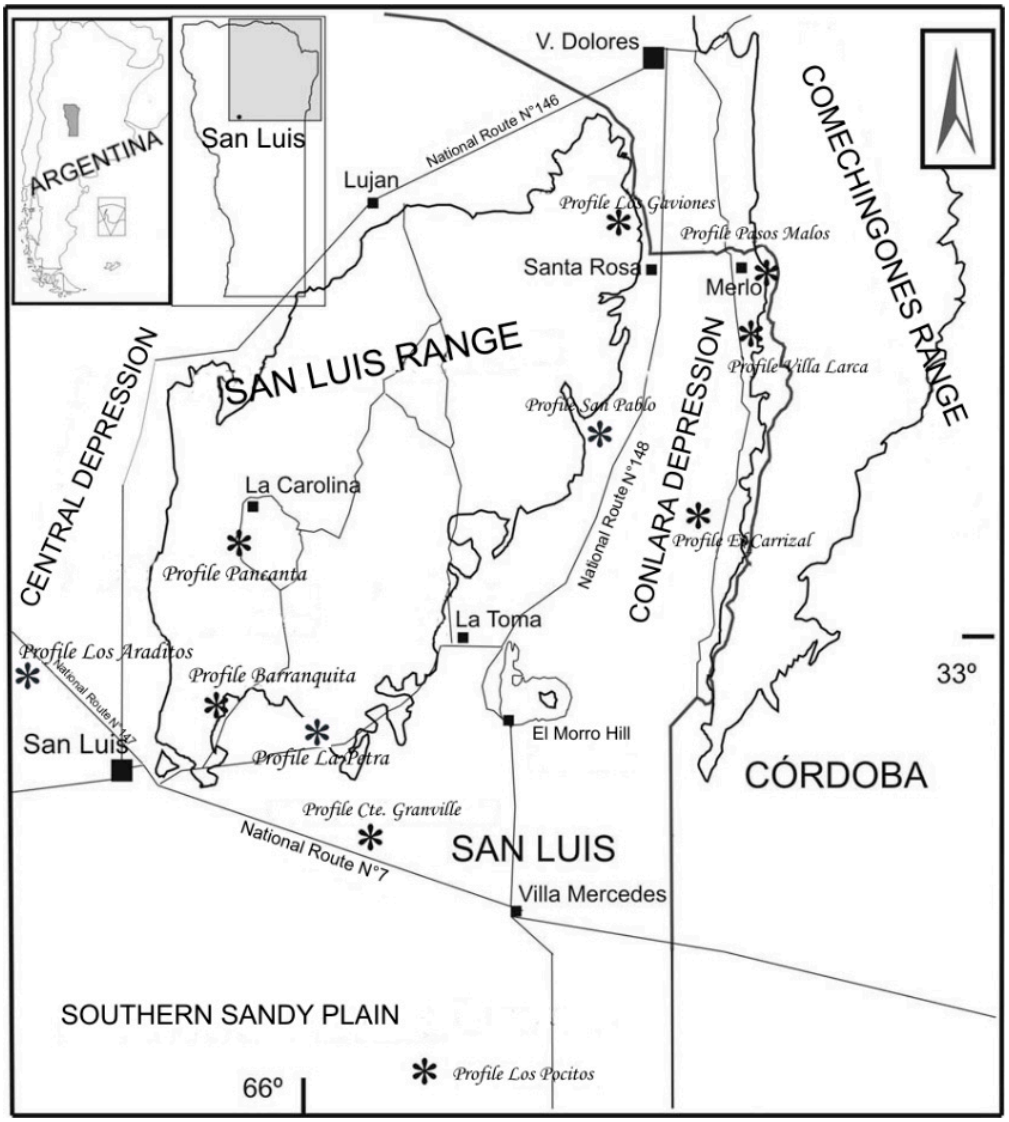


**Figure 1.** Geographic location of the studied area in San Luis Province, central Argentina. The asterisks indicate the geological profiles detailed in the text.

The first Pleistocene fossils in San Luis Province were recovered by local people from levels near the San Luis mountain range. Some of them, belonging to xenarthrans and ungulates, were illustrated in old contributions (e.g., [7–9]). Later, Frenguelli [10] identified different fossil taxa of megatheriids, mylodontids, glyptodontids, macrauchenids, camelids, equids, and ursids, together with remains of extant mammals; some of them presented numerous marks of carnivore and rodent bites. In turn, Gez [11] mentioned that Parodi found numerous fossils in 1927 south of Villa Mercedes, highlighting those from Sayapé Lake. Later papers [12–14] also mentioned Quaternary fossils assigned to *Sclerocalyptus*, *Glyptodon*, *Megatherium*, *Mylodon*, *Panochthus*, *Toxodon*, and *Equus argentinus*. In more recent decades, Pascual and Bondesio [1] updated the paleoenvironmental scheme and referred to the megamammals described by Frenguelli [10]. Finally, since the end of the 20th century, there have been significant records of fossils from the peripheral basins of the mountain region [2,5,15,16]. Detailed descriptions of the Quaternary fauna from San Luis are, however, scarce, and most contributions only provide lists of recorded taxa and short comments on each one [5,17].

The aim of this work is to update the knowledge of the Pleistocene–Holocene faunas of San Luis Province, in a biostratigraphic and chronological context, incorporating data from an unpublished doctoral thesis [18] and comparing them with other Quaternary assemblages of Argentina.

## 2. Material and Methods

Sedimentological and stratigraphic analyses follow previous works in the area of San Luis Province (e.g., [2]). The sedimentological sequences contain strata from different depositional environments that have provided mammal fossils and samples for radiocarbon dates. Gastropods, caraceae, diatoms, and pollen were exceptionally recorded. Stratigraphic profiles are based on traditional parameters such as texture, contacts, geometry, and structure, while systematic sampling allows for lab analyses to determine the texture, geochemistry, and color.

The studied fossil material is housed in the paleontological collection of the Facultad de Ciencias Físico, Matemáticas y Naturales, Universidad Nacional de San Luis (MHIN-UNSL-GEO V), San Luis city, Argentina. The systematic study has been based on a morphological and metrical comparison with other Pleistocene mammals materials, following the terminology and methods of specialized papers from each recorded group, mentioned in the descriptive sections.

Anatomical abbreviations used throughout the text: Cf/cf, upper/lower caniniform tooth; M, upper molar; Mc, metacarpal; Mf/mf, upper/lower molariform tooth.

## 3. Geological and Sedimentary Context

The studied sedimentary deposits bearing Quaternary fossil mammals cover the basins of the northern half of San Luis Province. In general, their base lies on the basement and the Neogene sedimentary rocks, and they are only exceptionally affected by tectonics. The exposed profiles are widely distributed and record the paleoclimate characteristics dominating the Upper Pleistocene and Lower Holocene.

Considering the paleontological record, the outcrops are grouped into the following areas: the San Luis Range and Río Quinto Basin, including profiles of Barranquita Creek, Pancanta Valley, La Petra Creek, and Comandante Granville; the Oriental or Conlara Depression, divided in the eastern sector that includes profiles of Pasos Malos and Villa Larca, and the western sector that includes El Carrizal Creek, Puente San Pablo, and Los Gaviones; the Southern Sandy Plain that includes Los Pocitos Lake; and finally, the Central Depression (Beazly Basin) that includes the profile of Los Araditos Creek (Figure 2).

### *3.1. San Luis Range and Río Quinto Basin*

The oldest Quaternary deposits in northern San Luis Province correspond to the Fraga Fm. (Upper Pleistocene). This formation is integrated by sandy gravels, with a channel geometry and parallel planar stratification at the base, cusp levels with gravel lenses, and a support matrix to support clast with an erosive base; coarse and medium sands overlie a neat, flat contact, with dominant cross-stratification, sometimes subordinated as planar and parallel. The entire deposit is brown-yellowish and friable to moderately consolidated. In the Río Quinto Basin, this succession represents a fluvial environment that overlies the Neogene Río Quinto Fm. through an erosive unconformity. The overlying levels correspond to the Alto Grande Fm. (Upper Pleistocene). This succession is constituted by medium gravels with a medium-sandy matrix, tabular geometry, and massive structure. It represents an alluvial succession that generally lies on the crystalline basement. The Barranquita Fm. (Upper Pleistocene–Lower Holocene) overlies with a neat and undulated contact. This formation corresponds to sand-silty loess deposits with a massive structure; it is poorly consolidated and of a brown-yellowish color. In some areas, there are fluvial channels at the base, with a fine-to-medium sandy texture and massive structure. Numerical dates from different profiles in the mountain piedmont (Figures 2 and 3) constrain the sedimentary unit between ca. 12,000 and ca. 8000 years BP [19]. An organic horizon overlies a neat and

flat contact, with little differentiation, and is identified as Los Toldos Paleosol (Holocene). It is represented by a sand-silty texture that forms granular polyhedral aggregates and subangular blocks greater than 10 cm, with moderate to strong cohesion and a dark brown color. It does not react to hydrochloric acid and the organic humus material content is 1.46%. Finally, the top of the sequence corresponds to the Algarrobito Fm. (Upper Holocene). It is constituted by friable 'loessoid' sediments with a sandy-silty texture and light brown color, with planar stratification at the base due to watery currents. This formation lies on the previous units through an erosive unconformity.

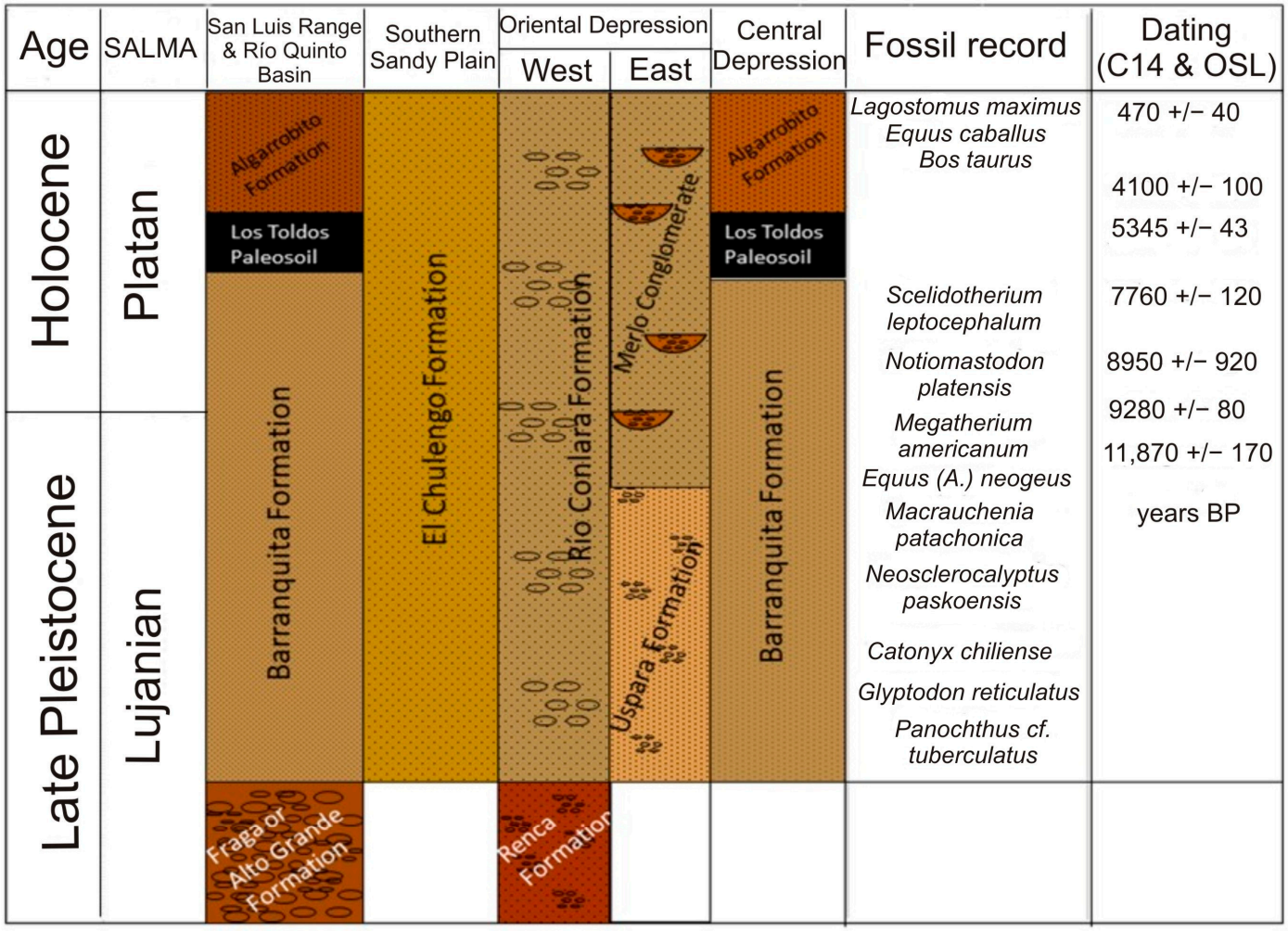


**Figure 2.** Regional distribution of Quaternary formations in San Luis Province, Argentina.

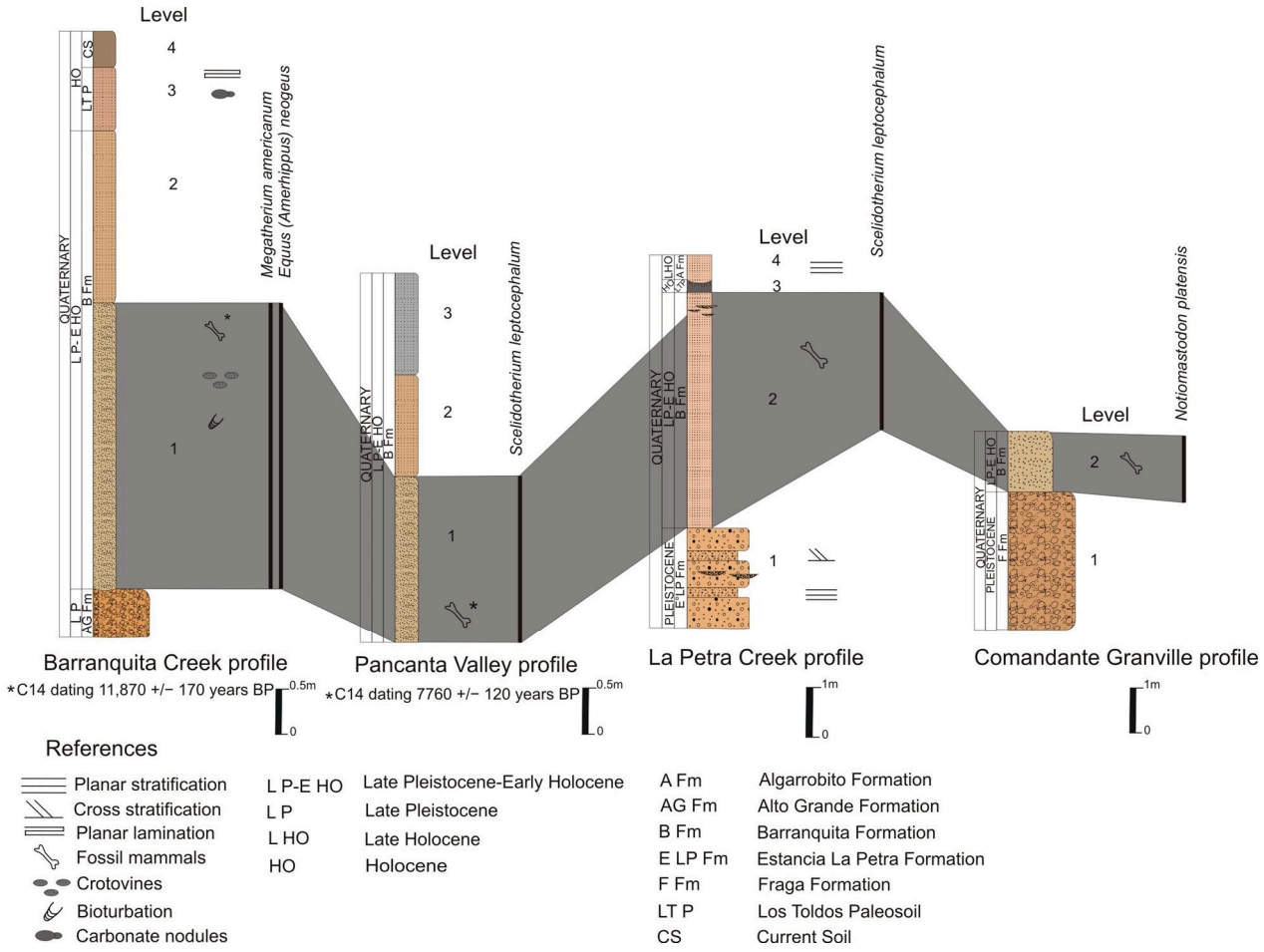


**Figure 3.** Stratigraphic correlation of piedmont profiles at Barranquita Creek, Pancanta, Estancia La Petra, and Comandante Granville.

### *3.2. Oriental or Conlara Depression*

#### 3.2.1. Oriental Sector (Pasos Malos Creek and Villa Larca Creek)

In this sector, the basement is characterized by a large rising front produced by inverse faults. Consequently, the overlying Quaternary deposits vary according to the zone. The studied profiles that provided fossil remains thus correspond to the Uspara Fm. (Upper Pleistocene–Lower Holocene), which underlies the Merlo Conglomerate (Figure 4).

The Uspara Fm. is mainly composed of silts and fine sands with dispersed very fine gravels and sometimes in thin channels; the deposits show a tabular geometry, massive structure, and brown-yellowish color, and they are moderately friable. However, at the base, it is possible to identify interbedded levels of medium to coarse gravels, a channel geometry, a crossed structure, and very fine sands, silts and fine-to-medium dispersed gravels, and a parallel planar structure of brown-yellowish color and moderate friability. The type of profile, with megafaunal remains, provided a radiocarbon date of 20,000 years BP (Schäbitz, personal comm.).

The Merlo Conglomerate is dominated by medium to coarse gravels, a channel geometry, and a massive chaotic structure; it is poorly selected and friable and interbedded with levels of coarse gravel-sands of a light-brown color and a sandy matrix that reacts to hydrochloric acid.

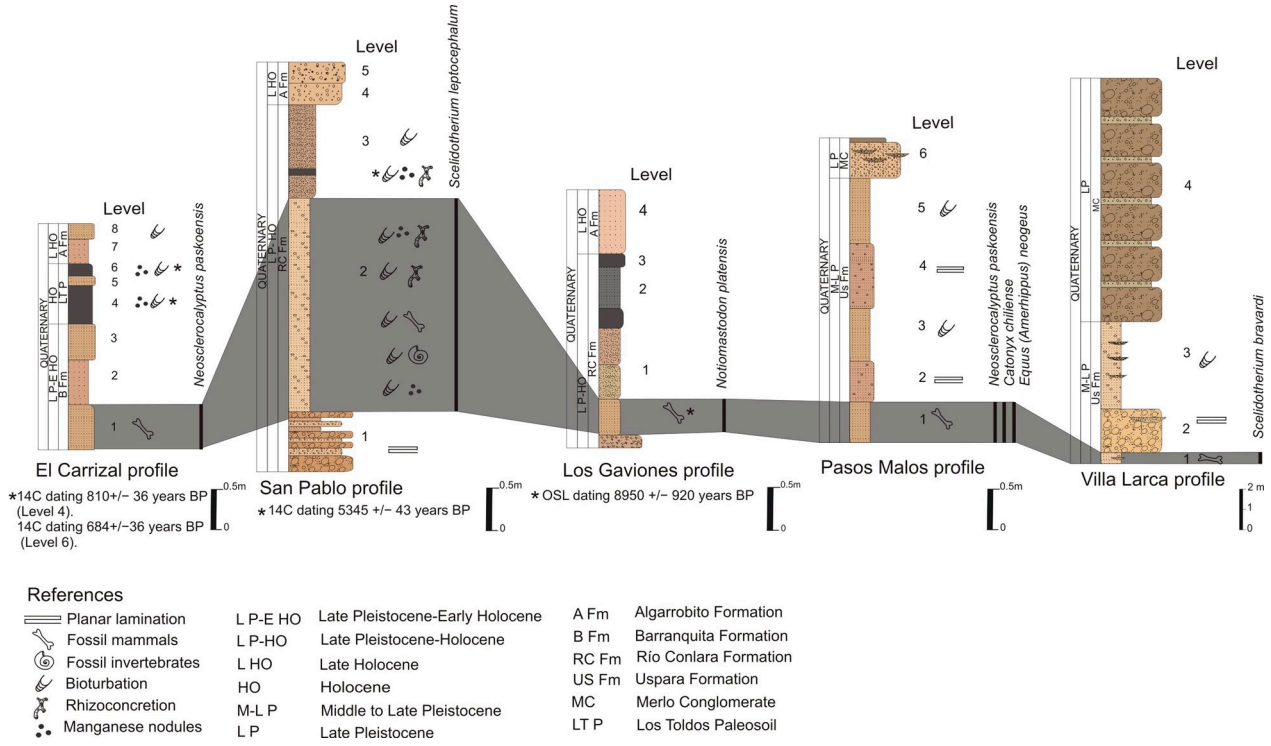


**Figure 4.** Stratigraphic correlation of profiles at different areas of the Conlara Depression: El Carrizal Creek, Puente San Pablo, Los Gaviones, Pasos Malos Creek, and Villa Larca.

#### 3.2.2. Western Sector (Conlara River Valley)

In this fluvial system of permanent waters, the basal strata correspond to the Renca Fm. (Upper Pleistocene). They are constituted by moderately consolidated gravels and sands of tabular geometry, and a massive and interbedded structure of a brown-reddish to greyish color. This unit is overlain by the Río Conlara Fm. (Upper Pleistocene–Holocene), which represents the extended sedimentary unit of the river ravines, and is constituted by silty sands, having a tabular geometry, a massive and laminar structure, with thin paleochannels of sands and fine gravels. It is moderately consolidated and of a brown-yellowish color (Figure 4). The numerical dates from different sectors of the basin place the middle levels of the unit from ca. 9000 years BP to 6000 years BP [2]. The top of this succession is represented by interbedded clays and fine silty sands, with a tabular geometry and laminar structure; they are moderately consolidated and of brown-greyish and olive colors. Finally, there is a stratum with pedogenetic evidence, silt and fine clayish sands, and a laminar structure, which is moderately consolidated and black-colored.

### *3.3. Southern Sandy Plain (Los Pocitos Lake)*

The outcropping sequence corresponds to a great dune whose base is identified as the El Chulengo Fm. (Upper Pleistocene–Holocene) (Figure 5). It is constituted by fine sand of low- and high-angled interbedded stratification; it is brown-yellowish to brown-greyish in color, well selected, and with slight cohesion. The basal levels correspond to the Nahuel Mapá Member (Upper Pleistocene), whose top presents a carbonate level with an organic horizon and a fine level (3–4 cm) of volcanic ash. Its assignment to the Upper Pleistocene is supported by the obtained numerical ages between ca. 40,000 years and 12,000 years BP [20]. The overlying Sayapé Member (Middle Holocene) is in turn overlain by the Los Pocitos Member (Upper Holocene). The sedimentary sequence represents the austral zone of the 'Mar de Arenas' (Sandy Sea) described by Iriondo [21], whose areas of the eolian contribution are placed in the West and South of San Luis Province.

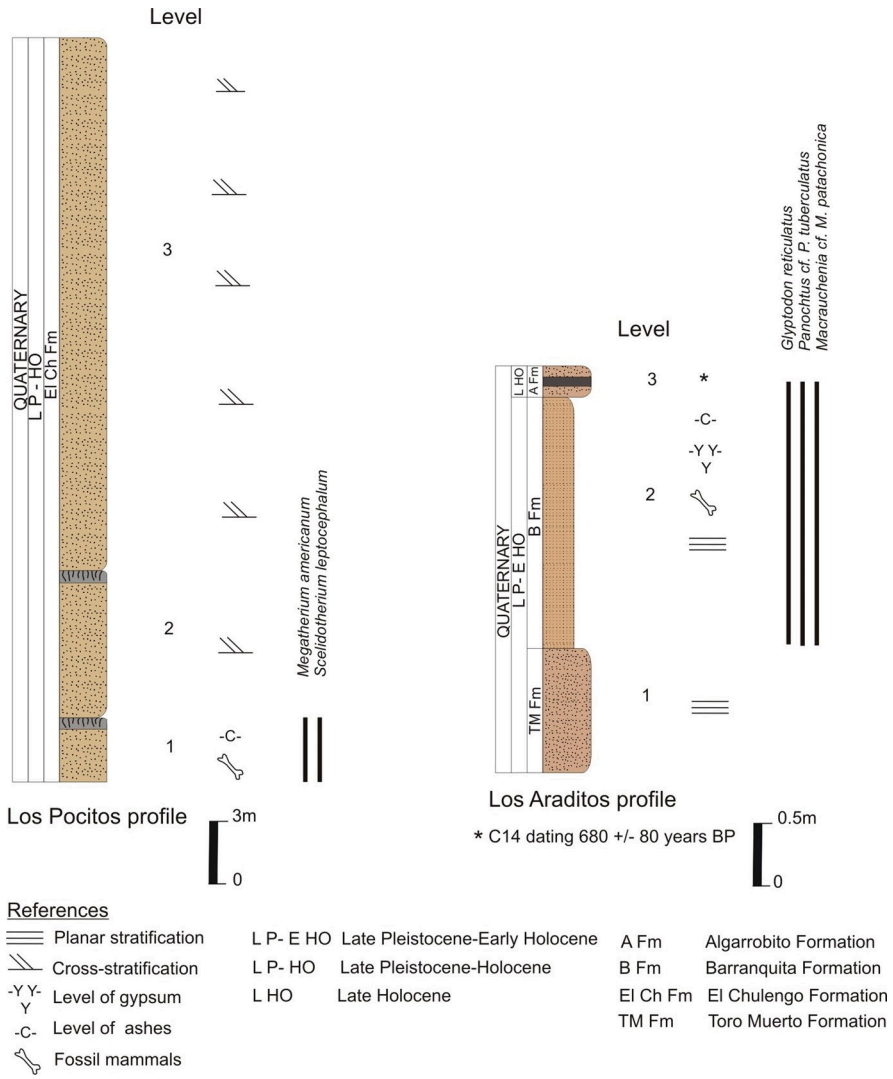


**Figure 5.** Stratigraphic profiles at Los Pocitos Lake and Los Araditos Creek.

### *3.4. Central Depression or Beazley Basin (Los Araditos Creek)*

In this area, the Quaternary deposits cover a large surface, overlying the Neogene sediments. The basal strata correspond to the Barranquita Fm. (Upper Pleistocene–Lower Holocene) (Figure 5), which is constituted by brown-yellowish-colored sands and silts of a tabular geometry, with dominant massive structures in the levels with incipient lamination, which are relatively consolidated. At the top, the Algarrobito Fm. (Upper Holocene) is characterized by the predominant sand of a laminar structure at the base; it is massive towards the top, relatively friable, and of a brown-grayish color. In some areas, an organic horizon is recognized at the base of the Algarrobito Fm. (Figure 5), which is composed of silts and fine sands, moderately consolidated to friable, and a dark-brown color.

## 4. Systematic Paleontology

### *4.1. Xenarthra Cope, 1889*

4.1.1. Cingulata Illiger, 1811

Glyptodontidae Gray, 1869

Hoplophorinae Huxley, 1864

Hoplophorinii Huxley, 1864

*Neosclerocalyptus paskoensis* (Zurita, 2002) [22]

(Figure 6A–I)

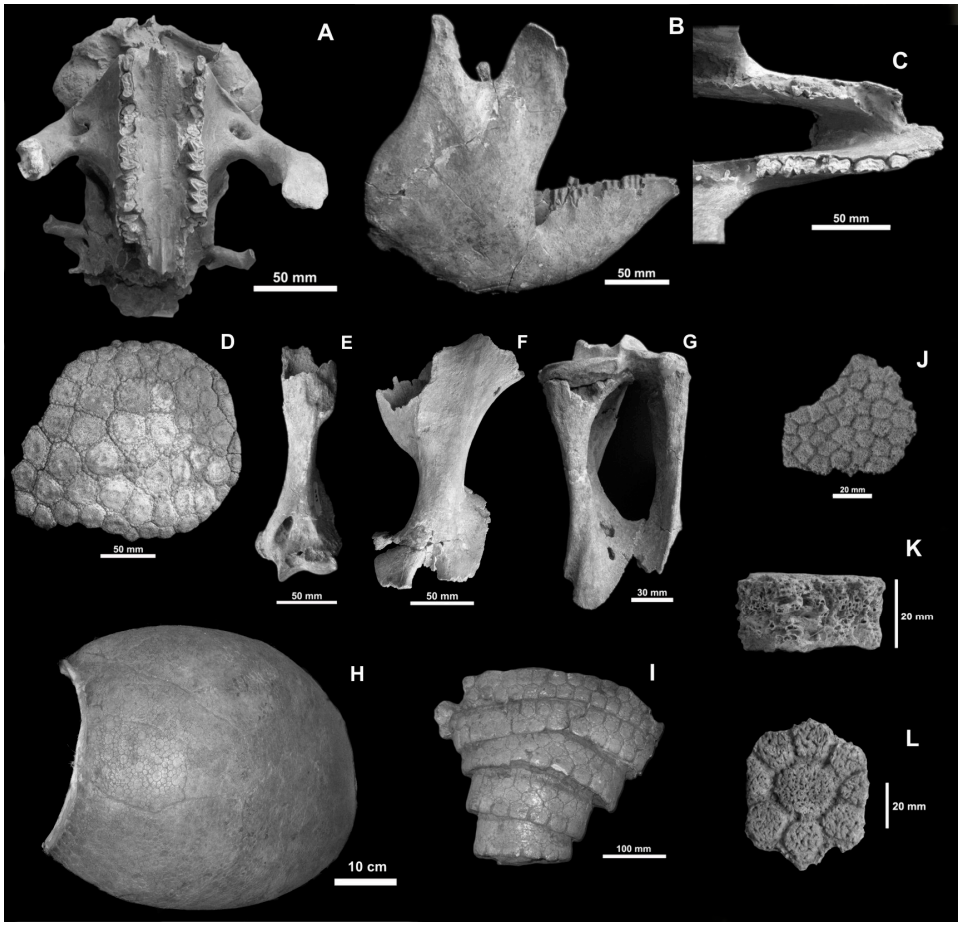


**Figure 6.** (**A**–**I**) *Neosclerocalyptus paskoensis*, (**A**–**H**) Barranquita Fm., El Carrizal Creek, (**A**) MHIN-UNSL-GEO V 488, skull, ventral view; (**B**,**C**) MHIN-UNSL-GEO V 489, (**B**) mandible, right lateral view; (**C**) details of dental series, occlusal view; (**D**) MHIN-UNSL-GEO V 490, cephalic shield, dorsal view; (**E**) MHIN-UNSL-GEO V 499, left humerus, anterior view; (**F**) MHIN-UNSL-GEO V 497, left femur, anterior view; (**G**) MHIN-UNSL-GEO V 498, left tibio-fibula, anterior view. (**H**,**I**) Uspara Fm., Pasos Malos Creek: (**H**) carapace, dorsal view; (**I**) caudal rings, dorsal view. (**J**) *Panochthus* cf. *P. tuberculatus*, Barranquita Fm., Los Araditos Creek, MHIN-UNSL-GEO V 638, osteoderm, dorsal view. (**K**,**L**) *Glyptodon reticulatus*, Papagayos Creek, Conlara Depression, osteoderm, (**K**) dorsal view, (**L**) lateral view.

- Referred material. MHIN-UNSL-GEO V 198, complete dorsal carapace; Uspara Fm., Pasos Malos Creek, Merlo. MHIN-UNSL-GEO V 487–500, carapace, cephalic shield, caudal ring fragments, skull, mandible, vertebrae, ribs, scapula, pelvis, humeri, left ulna and radius, femora, tibio-fibulae, carpals, and tarsals of a single individual; Barranquita Fm., El Carrizal Creek.
- Comments. The referred material had been mentioned by Bargo et al. [17], but the detailed data remained unpublished [18]. Morphological features correspond to *Neosclerocalyptus paskoensis* [22]. The dorsal carapace is oval and low, with a rather straight dorsal profile. The dorsal osteoderms are thin (3 mm thick), hexagonal to quadrangular, with well-defined sutures and piliferous foramina; the central figure is oval, somewhat depressed, and surrounded by small peripheral figures. Ventral osteoderms are smaller, rectangular, anteroposteriorly long, with a large central figure, and small or lacking peripheral figures. Caudal rings are formed by a double row of osteoderms, with strongly developed piliferous foramina. The skull has the parieto-temporal region directed ventrally; there is a concavity from the nuchal crest to the posterior third of frontals; the descending maxillary processes are not robust;

frontonasal sinuses are strongly pneumatized and expanded laterally, with their borders separated from the rest of the skull; nasal cavities are separated from each other by a robust septum. The mandible is particularly slender in the ascending ramus, and the condyle and the coronoid process are approximately at the same level. Dimensions of different specimens are shown in the Supplementary Material, Tables S1 and S2. The femur MHIN-UNSL-GEO V 497 has a maximal length of 260 mm and a minimal width of the diaphysis of 54 mm. The length of the tibia MHIN-UNSL-GEO V 498 is 180 mm.

- Panochthini Castellanos, 1927

  *Panochthus* cf. *P. tuberculatus* (Owen, 1845) Burmeister, 1866 [23,24]
  (Figure 6J)

- Referred material. MHIN-UNSL-GEO V 638, 10 osteoderms of the dorsal carapace; Barranquita Fm., Los Araditos Creek.
- Comments. The osteoderms are very thick, with ornamentation composed of small polygonal, flattened figures, without differentiating a central figure or an ordering pattern. They resemble those of *Panochthus tuberculatus*, but the scarce material leads us to maintain a tentative identification.

  Glyptodontinae Gray, 1869
  *Glyptodon reticulatus* Owen, 1845 [23]
  (Figure 6K–L)

- Referred material. MHIN-UNSL-GEO V 583, three osteoderms of the dorsal carapace; Uspara Fm., Papagayos Creek, Conlara Depression, Oriental sector. MHIN-UNSL-GEO V 466, 12 osteoderms of the dorsal carapace; Barranquita Fm., Los Araditos Creek.
- Comments. The osteoderms are very thick (20 mm) and show a central figure limited by a subcircular groove and radial grooves that delimit eight subcircular-polygonal peripheral figures. The surface of the osteoderms is rugose, with vascular and piliferous foramina. The fossil-bearing levels at Los Araditos Creek can be correlated with those at Chosmes Creek, in which an unpublished radiocarbon dating of a paleosol provides an age of around 7000 years (JOC personal data).

#### 4.1.2. Pilosa Flower, 1883

Mylodontiidae Gill, 1872

Scelidotheriinae Ameghino, 1904
*Scelidotherium leptocephalum* Owen, 1838 [25]
(Figure 7A–I)

- Referred material. MHIN-UNSL-GEO V 200–211, tooth, caudal vertebrae, synsacrum, humeri, femora, tibiae, and left calcaneum; Barranquita Fm., Pancanta profile. MHIN-UNSL-GEO V 513, third phalanx; Barranquita Fm., La Petra Creek. MHIN-UNSL-GEO V 536, five lower and upper molariforms; Río Conlara Fm., Puente San Pablo, Conlara Valley. MHIN-UNSL-GEO V 690, left maxillary fragment with complete dentition, El Chulengo Fm., Los Pocitos Lake, Southern Sandy Plain.
- Comments. Chiesa et al. [2] indicated an age of 7760 ± 120 years BP for levels in which MHIN-UNSL-GEO V 200–211 were found. Lucero [18], however, mentioned that MHIN-UNSL-GEO V 536 comes from a level placed below a paleosol dated to 5345 ± 43 years BP. Bargo et al. [17] mentioned the specimens MHIN-UNSL-GEO V 200-211, MHIN-UNSL-GEO V 372 (see below for this specimen) from Villa Larca Creek (Uspara Fm.), and MHIN-UNSL-GEO V 513 but without any description. Molars of MHIN-UNSL-GEO V 536 are identified as *S. leptocephalum* based on the following characters: caniniform cf1 subtriangular, with a small lingual lobe, and molariform mf3 slightly curved lingually in the posterior lobe. The complete series MHIN-UNSL-GEO V 690 occupies a length of 60 mm; Cf1 and Mf1–4 are subelliptic or subtriangular, obliquely implanted, and slightly anteroposteriorly elongated. The humerus is proximally massive, with a short diaphysis, and it enlarges distally; the entepicondylar

foramen is preserved. The femur fragments lack the proximal epiphysis; the bone is anteroposteriorly flattened. The tibia is short and independent of the fibula. The calcaneus is large and extended posteriorly, with a typical distolateral diagonal crest. The astragalus has the typically concave cuboid facet of Scelidotheriinae and has a medial odontoid condyle. Dimensions of these bones can be found in the Supplementary Material, Tables S3 and S4. The ungual phalanx shows the proximal articulation extended posteriorly, with a crest between the two parallel facets; the palmar face has two large, deep foramina close to the articular border. The total length of the phalanx is 160 mm.

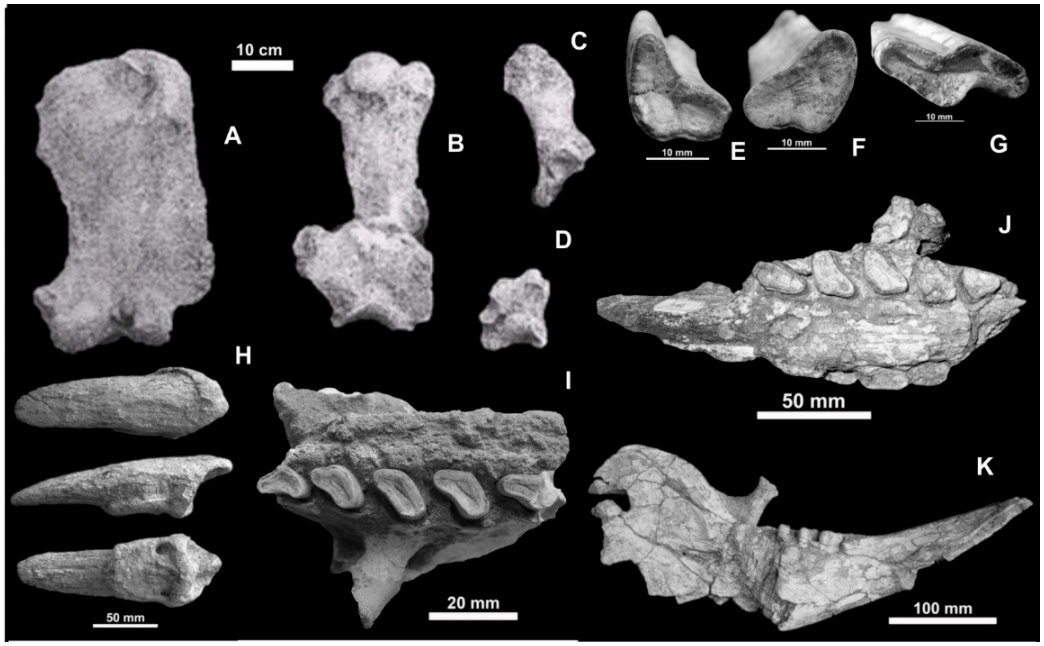


**Figure 7.** (**A**–**I**) *Scelidotherium leptocephalum*. Barranquita Fm., La Petra Creek, (**A**) MHIN-UNSL-GEO V 201, left femur, posterior view; (**B**) V 203, right humerus, anterior view; (**C**) V 209, left calcaneus; (**D**) V 207, right astragalus; (**E**–**G**) Río Conlara Fm., San Pablo, Conlara Depression, MHIN-UNSL-GEO V 536, (**E**) mf1, (**F**) mf3, (**G**) Mf1 or Mf2, occlusal views; (**H**) Barranquita Fm., La Petra Creek, MHIN-UNSL-GEO V 513, ungueal phalanx, dorsal, lateral and distal views; (**I**) El Chulengo Fm., Los Pocitos Lake, MHIN-UNSL-GEO V 690, left maxillary fragment with five molariforms, occlusal view. (**J**,**K**) *Scelidotherium bravardi*, Uspara Fm., Villa Larca, MHIN-UNSL-GEO V 372, (**J**) skull fragment, palatal view; (**K**) mandibular fragment, lingual view.

*Scelidotherium bravardi* Lydekker, 1886 [26]

- (Figure 7J,K)
- Referred material. MHIN-UNSL-GEO V 372–374, cranial fragment with left jugal series and remains of right teeth, left mandibular fragment, and vertebral and rib remains; Uspara Fm., Villa Larca Creek.
- Comments. The horizontal ramus of the mandible shows a narrow, smoothly curved anterior area, twice as long as that occupied by jugal teeth. Upper teeth are prismatic, subtriangular-subelliptic in outline, anteroposteriorly elongated, and very oblique with respect to Cf1; Mf4 is smaller than the other molariforms. These remains were preliminarily identified as *Scelidotherium* cf. *S. leptocephalum* but later recognized as *S. bravardi* based on the mandibular morphology and a smaller size than *S. leptocephalum* [16,27]. The main dimensions of the mandible are as follows: total length = 380 mm; pre-dental length = 180 mm; height of the horizontal ramus at the level of mf1 = 85 mm.

*Catonyx chiliensis* (Lydekker, 1886) [26]
(Figure 8A)

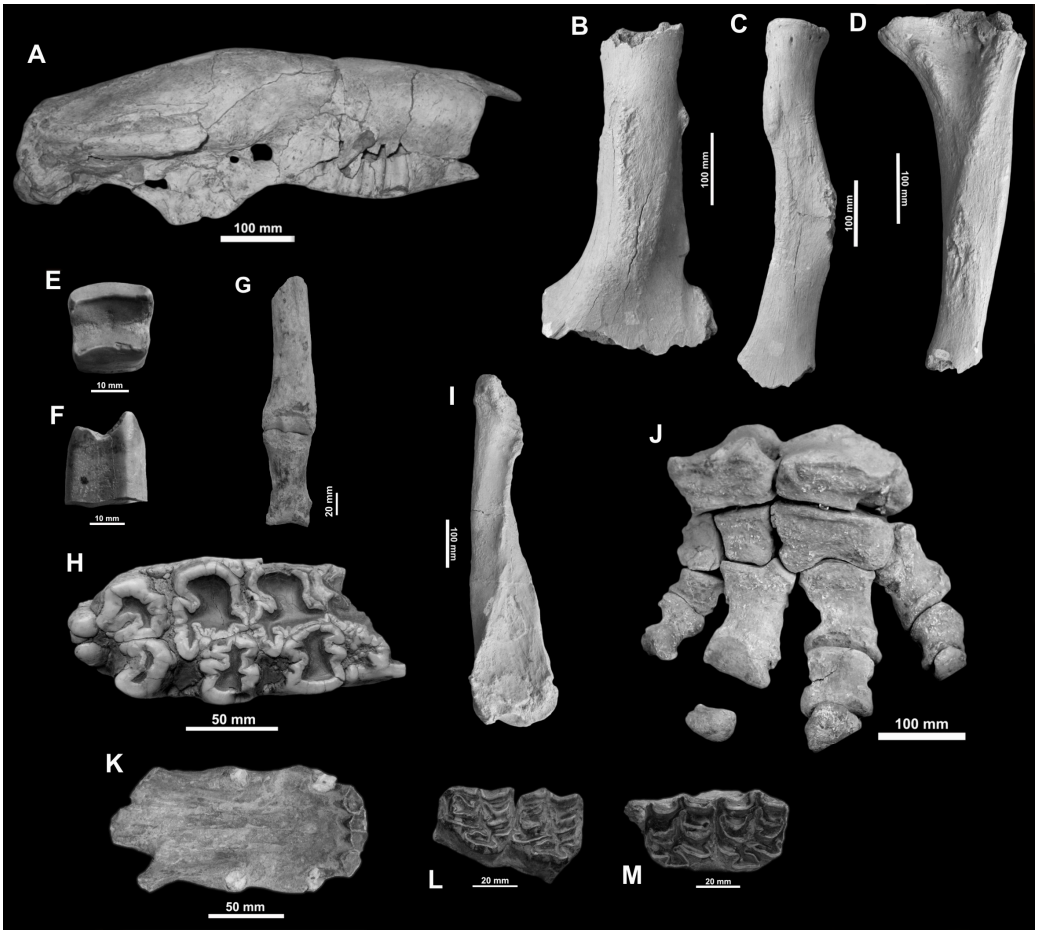


**Figure 8.** (**A**) *Catonyx chiliensis*, MHIN-UNSL-GEO V199, partial skull, right lateral view. (**B**–**F**) *Megatherium americanum*, Barranquita Fm., Barranquita Creek, (**B**) MHIN-UNSL-GEO V 215, left humerus fragment, anterior view; (**C**) V 213, left radius, lateral view; (**D**) V 214, left ulna, anterior view; (**E**,**F**) MHIN-UNSL-GEO V 512, molariform, occlusal and labial views. (**G**) *Macrauchenia patachonica*, Barranquita Fm., Los Araditos Creek, MHIN-UNSL-GEO V 467, lateral metacarpal (Mc II?) and first phalanx. (**H**–**J**) *Notiomastodon platensis*, Río Conlara Fm., Punta del Agua, MHIN-UNSL-GEO V 376, (**H**) lower molar, occlusal view; (**I**) V 222, right radius, anterior view; (**J**) V 510, left manus, anterior view. (**K**–**M**) *Equus (Amerhippus) neogeus*, Uspara Fm., Pasos Malos Creek, Merlo, MHIN-UNSL-GEO V 468, (**K**) palatal fragment with incisors and canines, ventral view, (**L**) left M1–2, occlusal view, (**M**) right M2–3, occlusal view.

- Referred material. MHIN-UNSL-GEO V 199, partial skull with only the right Cf1.
- Uspara Fm., Pasos Malos Creek (Merlo).
- Comments. This is one of the few Quaternary remains from San Luis that have been figured and described in detail [4]—as *Scelidodon chiliense*—and also included in a more recent paper by Miño-Boilini and Quiñones [28], in which materials from Tucumán Province and outside Argentina (Peru, Bolivia, Chile, and Ecuador) are also ascribed to *Catonyx chiliensis*. MHIN-UNSL-GEO V 199 was wrongly mentioned by Bargo et al. [17] as coming from Villa Larca Creek.

Megatheriidae Gray, 1821

Megatheriinae Gill, 1872
*Megatherium americanum* Cuvier, 1796 [29]
(Figure 8B–F)

- Referred material. MHIN-UNSL-GEO V 212–220, and V 511, right mf1 and mf4, and not associated postcranial remains. Barranquita Fm., Barranquita Creek. MHIN-UNSL-GEO V 512, one tooth and maxillary fragments, El Chulengo Fm., Los Pocitos Lake.
- Comments. Concerning the fossils from the Barranquita Profile, there is a radiocarbon date of 11,870 ± 170 years BP [2]. Besides the referred material, Bargo et al. [17] also mentioned a femur from the Fraga Fm. at Cantera Díaz Nogarol in the Río Quinto Basin, but this bone is not stored in an official institution.

Long bones from Barranquita Creek (Supplementary Material, Table S5) belong to a young individual, as revealed by non-ossified epiphyses. The lower molars are subquadrangular, slightly narrowed posteriorly, with convex anterior and posterior borders, while lingual and buccal sides are slightly concave; transversal crests are narrow and well separated from each other. MHIN-UNSL-GEO V 212 would correspond to an adult individual, while MHIN-UNSL-GEO V 512 is assigned to a juvenile due to the molar proportions.

*Megatherium americanum* is likely the most outstanding representative of the Quaternary South American megafauna, being the largest ground sloth, with an estimated body mass that would surpass 5 tons (e.g., [30]).

### *4.2. Litopterna Ameghino, 1889*

#### 4.2.1. Macraucheniidae Gervais, 1855

Macraucheniinae Gervais, 1855

*Macrauchenia patachonica* Owen, 1838 [25]
(Figure 8G)

- Referred material. MHIN-UNSL-GEO V 467, lateral metacarpal (Mc II?) fragment and first phalanx in anatomical connection. Barranquita Fm., Los Araditos Creek.
- Comments. The distal curvature of the preserved metapodial allows its identification as a lateral digit (II or IV); it could correspond to a metacarpal rather than to a metatarsal, as the latter is more regularly concave [31,32] than in MHIN-UNSL-GEO V 467. The phalanx is high and relatively narrow, slightly asymmetrical, and its dimensions (Supplementary Material, Table S6) fall into the size range of *M. patachonica*, rather close to the mean values provided by Guérin and Faure [33]. This species is another common element of the Lujanian megafauna in Argentina and other South American areas.

### *4.3. Proboscidea Illiger, 1811*

#### 4.3.1. Gomphotheriidae Cabrera, 1929

Anancinae Hay, 1922

*Notiomastodon platensis* (Ameghino, 1888) [34]
(Figure 8H–J)

- Referred material. MHIN-UNSL-GEO V 376, molar; MHIN-UNSL-GEO V 510, 515, 221–224, associated postcranial elements (vertebrae, scapula, forelimb bones, and tibia), Río Conlara Fm., at Punta del Agua, Los Gaviones Profile (Conlara Depression, Western sector). MHIN-UNSL-GEO V 377–378, two worn molars, Fraga Fm., Comandante Granville Profile.
- Comments. The material from Punta del Agua comes from sediments dated by OSL to 8950 ± 920 years BP [2]. The recovered molars are incomplete and most are very worn; only MHIN-UNSL-GEO V 376 clearly shows the "clover" morphology, with few identified accessory conules; the enamel is typically rugose and striated along the crown base; transverse valleys are narrow; there is a uniform, thin cover of cement,

except in the medial sulcus, where the main cusps of pretrite and postrite are in close contact. Postcranial bones are large and massive (Supplementary Material, Table S7). The most complete humerus shows a greatly developed epicondylar crest and a subcircular olecranian fossa; the radius has a subcircular, concave proximal facet. The preserved forefoot shows wide and short carpal bones, with flattened articular facets, and shortened metacarpals and phalanges. Both the dentition and bones can be clearly identified as the mastodon *Notiomastodon platensis*, a species broadly distributed in Argentina during the Upper Pleistocene.

### *4.4. Perissodactyla Owen, 1848*

#### 4.4.1. Equidae Gray, 1821

Equinae Steinman and Doderlein, 1890

*Equus (Amerhippus) neogeus* Lund, 1840 [35]
(Figure 8K–M)

- Referred material. MHIN-UNSL-GEO V 218a-b, two fragments of scapula, and V 468, a palatal fragment with incisors and canines, as well as maxillary fragments with molars, Barranquita Fm., Barranquita Creek. MHIN-UNSL-GEO V 227, isolated M1 and M2, Uspara Fm., Pasos Malos Creek (Merlo).
- Comments. The material from Barranquita Creek has a radiocarbon date of 11,870 ± 170 years BP [2]. The teeth show diagnostic characteristics of *E.* (*A.*) *neogeus*. They show projected parastyle and metastyle, limiting an angled concavity, a rounded metacone, a subtriangular protocone, a large hypocone, with a well-defined hypoconal sinus, wide fossettes, and a reduced pli caballin. The scapular fragments are not particularly diagnostic. Bargo et al. [17] mentioned both the scapula and the M1–2 as *Equus* (*A.*) cf. *E.* (*A.*) *neogeus*.

*Equus* (*Amerhippus*) *neogeus* is the largest South American horse [36,37]. It is well known in Pleistocene sites of Argentina, Brazil, Colombia, and Uruguay. This species has been the subject of numerous studies and is a typical element of the Lujanian fauna (e.g., [36–38] and references therein).

## 5. Final Remarks

The described taxa are all typical elements of the Upper Pleistocene–Lower Holocene epochs, particularly corresponding to the Lujanian Stage/Age. A few species are also known from the older Ensenadan and Bonaerian, but some are exclusive of the Lujanian, which agrees with the absolute dates obtained for several assemblages and with the stratigraphic data. In this sense, the equid *Equus* (*Amerhippus*) *neogeus* was selected as the fossil guide for a biozone that characterizes the Lujanian ([39] and the references therein). Nevertheless, representatives of a certain biozone are not necessarily exclusive of it. This is the case with the *Megatherium americanum* Biozone that supports the Ensenadan Stage/Age, as this taxon persisted throughout the Lujanian. Based on the fossil record from San Luis Province and Lucero's unpublished data [18], Chiesa et al. [2] proposed the *Neosclerocalyptus paskoensis-Equus* (*Amerhippus*) *neogeus* Biozone, with its type area in the piedmont south of the San Luis Range.

Comparisons with other geographical areas of Argentina (Table 1) show general similarities in the taxa composition with all of them. Among xenarthrans, *N. paskoensis* was first recognized in the Lujanian Stage/Age of the Chaco Province [22] and later in the Lujanian levels of Buenos Aires, La Pampa, Córdoba, Tucumán, Santa Fe, and Corrientes [40]. *Panochthus tuberculatus*, the type species of the genus, is known in the Bonaerian and Lujanian Stages/Ages (latest Middle Pleistocene to Upper Pleistocene) across a great part of Argentina, from the Chaco-Pampean and Mesopotamian regions to the southern Santa Cruz Province; it is also present in Uruguay, southern Brazil, Paraguay, and maybe Bolivia [41]. *Panochthus* sp. and cf. *Panochthus* have been mentioned in two Quaternary localities of La Pampa Province [17]. The species *Glyptodon reticulatus* is mainly known from the Lujanian levels of Buenos Aires and Córdoba provinces; it is also recognized

in Entre Ríos Province [42,43], and *Glyptodon* sp. has been mentioned in the Quaternary of Mendoza (near El Carrizal dam and Costa Anzorena [44]) and the Mesopotamian Region [45], while *Glyptodon clavipes* is recognized in La Pampa [17,46]. Among terrestrial sloths, the mylodontid *Scelidotherium* is recorded throughout the Pleistocene–Holocene of Argentina. *Scelidotherium bravardi* is known in the Middle Pleistocene (Ensenadan) of Buenos Aires and the Upper Pleistocene (Lujanian) of San Luis, whereas *S. leptocephalum* spread from the Middle–Upper Pleistocene to the lowest Holocene (Bonaerian–Lujanian), with a wider geographical distribution in Argentina (Buenos Aires, Chaco, Córdoba, Corrientes, Entre Ríos, Formosa, Salta, San Luis, and Santa Fe provinces), as well as in the Upper Pleistocene of Uruguay [28]. In addition, there are records of *Scelidotherium* sp. in La Pampa [46] and Scelidotheriinae indet. in Santiago del Estero [47]. Undetermined mylodontid remains were also recorded in Mendoza [17]. The other recognized mylodontid Scelidotheriinae, *Catonyx chiliensis*, is widely spread in South America but only known from the Late Pleistocene of San Luis and Tucumán in Argentina [28]. Concerning megatheriids, *Megatherium americanum* is one of the first known Pampean megamammals, mainly from materials recovered in Buenos Aires Province (see Cattoi in Pascual [48] and the references therein), and it has been recorded—but not described in detail—in several localities of La Pampa [17,45,49]. Also, a femur from El Borbollón, in Mendoza, was first assigned to *M. americanum* by Rusconi [50] but recently considered as *Megatherium* sp. [17,44]. Other materials from Mendoza come from Gruta del Indio, Gruta El Manzano, and Agua de Pérez, without reaching a reliable specific determination [44]. *Megatherium* sp. is also recognized in Santiago del Estero [48].

**Table 1.** Upper Pleistocene–Holocene (Lujanian) mammal taxa from San Luis Province compared to other coeval Argentinean faunas. Abbreviations: Bs.As., Buenos Aires Province; Cba., Córdoba Province; Mza., Mendoza Province; NEA, northeastern Argentina; NOA, northwestern Argentina; Stgo. E., Santiago del Estero Province. * Wide distribution, as far south as Santa Cruz Province (see text); ** Present in other areas during the Ensenadan.

| Taxa | San Luis | Mza. | La Pampa | Bs.As. | Cba. | NOA | NEA | Chaco | Stgo. E. |
|---|---|---|---|---|---|---|---|---|---|
| *Neosclerocalyptus paskoensis* | X | | X | X | X | X | X | X | |
| *Panochthus tuberculatus* * | cf. | | | X | X | X | X | X | |
| *Panochthus* sp. | | | X | | | | X | | |
| *Glyptodon reticulatus* | X | | | X | X | | X | | |
| *Glyptodon clavipes* | | | X | | | | | | |
| *Glyptodon* sp. | | X | | | | | X | | |
| *Scelidotherium leptocephalum* | X | | | X | X | X | X | X | |
| *S. bravardi* ** | X | | | | | | | | |
| *Scelidotherium* sp. | | | X | | | | | | |
| Scelidotheriinae indet. | | X | | | | | | | X |
| *Catonyx chiliensis* | X | | | | | X | | | |
| *Megatherium americanum* | X | | X | | | | X | | |
| *Megatherium* sp. | | X | | | | | | | X |
| *Macrauchenia patachonica* | X | cf. | | X | X | X | X | | |
| *Notiomastodon platensis* | X | | | X | X | | X | | X |
| *Equus (A.) neogeus* | X | cf. | | X | | X | cf. | | |
| *Equus (A.)* sp. | | X | X | | | | | | |

The macraucheniid *Macrauchenia patachonica* is widely distributed across South America, from the Atlantic coast of Brazil to southern Chile [51]. In Argentina, *M. patachonica* is doubtfully recorded in the Ensenadan, but it is very abundant in Bonaerian and Lujanian of the Pampean Region (Buenos Aires, Santa Fe, and Córdoba provinces), Mesopotamia (Corrientes and Entre Ríos provinces), the north-northwestern area (Formosa and Jujuy provinces), and Patagonia (Santa Cruz Province) [32,42]. In addition, cf. *Macrauchenia* is mentioned for Gruta del Indio-Atuel IV in Mendoza Province [44]. The most recent remains of *M. patachonica* seem to correspond to Arroyo Seco, site 2 (Buenos Aires Province), dated to 8390 ± 140 years BP [39].

Gomphotheriid mastodons arrived in South America as part of the Great American Biotic Interchange through the Panamanian Isthmus, and the oldest accurate remains are those from Tarija (Bolivia). The spread of mastodons in South America would have followed two different migration ways, one through the Andes range, established for the genus *Cuvieronius*, and the second one through the Brazilian plains for the genus *Stegomastodon* ([52–54] and the references therein). Mothé et al. [55] proposed that the gomphotheres of the South American plains should be included in the genus *Notiomastodon*, differentiating them from the North American *Stegomastodon*; therefore, the usual references to *Stegomastodon platensis* are now considered to refer to *Notiomastodon platensis*. *Notiomastodon* is thus known in the Middle(?)–Upper Pleistocene of Argentina, Brazil, Paraguay, and Uruguay and the Upper Pleistocene of Ecuador, Peru, Chile, Colombia, and Venezuela. The species *N. platensis* is mainly known in Argentina, in the provinces of Buenos Aires, Córdoba, Santa Fe, Entre Ríos, and Santiago del Estero, but also in Uruguay and probably Paraguay [42,53]. Detailed descriptions of Argentinean materials can be found in [47,53,56]. In addition, *Notiomastodon* remains have been the object of isotopic analyses ($^{13}C$ and $^{18}O$) that have provided interesting results with respect to the paleoenvironmental and dietary characteristics of these megamammals, establishing differences in diet preferences among populations from different areas within Argentina [53,57]. Absolute dating based on $^{14}C$ has also been obtained from enamel fragments of *N. platensis* (e.g., 19,900 ± 120 years BP for the material of Santiago del Estero [54]).

Finally, the equid *Equus (Amerhippus) neogeus* is a common species in the Upper Pleistocene of Buenos Aires Province, as well as in other South American areas ([36,37] and the references therein). Other reports of equids in Argentina are those from Mendoza [44,58,59]; Santiago del Estero [60]; La Pampa [17,46]; Entre Ríos [42]; and Catamarca [61]. As mentioned for gomphotheres, South American equid remains have also been the object of isotopic analyses [62], establishing adaptive differences throughout the Pleistocene.

An outstanding fact about the recovered Quaternary fauna from San Luis herein reviewed is the lack of any record of the notoungulate *Toxodon* (Toxodontidae). Gez [11], however, mentioned remains of *Toxodon* from Cerritos Blancos and La Morena (Río Conlara Basin), as well as among the fossils recovered by Lorenzo Parodi at Sayapé (Southern Sandy Plain), but without further information; the material could not be located. *Toxodon* is one of the most emblematic megamammals of the South American Upper Pleistocene, mainly from the Pampean Region but also from other areas such as northeastern Argentina; it is mainly represented by the type species *T. platensis* [51,63].

The end of the Pleistocene marks the extinction of most megamammals worldwide. In South America, a few taxa survived into the Lower Holocene. In any case, around 50 genera became extinct; three orders, Notoungulata, Litopterna, and Proboscidea, as well as the large-sized xenarthrans, disappeared. There is no single explanation for this global extinction; it was related to rapid climate changes that affected the vegetation communities, but differences exist from one region to another. The arrival of humans in South America, particularly in Argentina, also seems to have played an important role ([64] and the references therein). Recently, predation by humans was considered a main factor in the South American megafaunal decline, together with Late Pleistocene environmental changes ([65] and the references therein).

**Supplementary Materials:** The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/quat6040059/s1, Table S1. Skull and upper dental measurements (in mm) of *Neosclerocalyptus paskoensis* from Barranquita Fm., El Carrizal. Abbreviations: L, length; Mf, upper molariform; W, width. Table S2. Mandible and lower dental measurements (in mm) of *Neosclerocalyptus paskoensis* from Barranquita Fm., El Carrizal. Abbreviations: L, length; mf, lower molariform; W, width. Table S3. Dimensions (in mm) of long bones of *Scelidotherium leptocephalum* from Barranquita Fm., Pancanta Valley. Abbreviations: APD, anteroposterior diameter; dis., distal; distolat., distal-lateral side; distomed., distal-medial side; L, length; Max., maximal; TD, transversal diameter. Table S4. Dimensions (in mm) of calcaneus and astragalus of *Scelidotherium leptocephalum* from Barranquita Fm., Pancanta Valley. Abbreviations: APD, anteroposterior diameter; L, length; Max., maximal; TD, transversal diameter. Table S5. Postcranial measurements (in mm) of *Megatherium americanum* from Barranquita Fm., Arroyo Barranquita. Abbreviations: L, length; Max., maximal; TD, transversal diameter. Table S6. Dimensions (in mm) of the first phalanx of *Macrauchenia patachonica* from Barranquita Fm., Arroyo Los Araditos. Abbreviations: APD, anteroposterior diameter; L, length; Max., maximal; TD, transversal diameter. Table S7. Postcranial measurements (in mm) of *Notiomastodon platensis* from Río Conlara Fm., Punta del Agua. Abbreviations: ant., anterior; APD, anteroposterior diameter; H, height; L, length; Max., maximal; post., posterior; Prox., proximal; TD, transversal diameter.

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