

## The Cambrian System in Northwest Argentina

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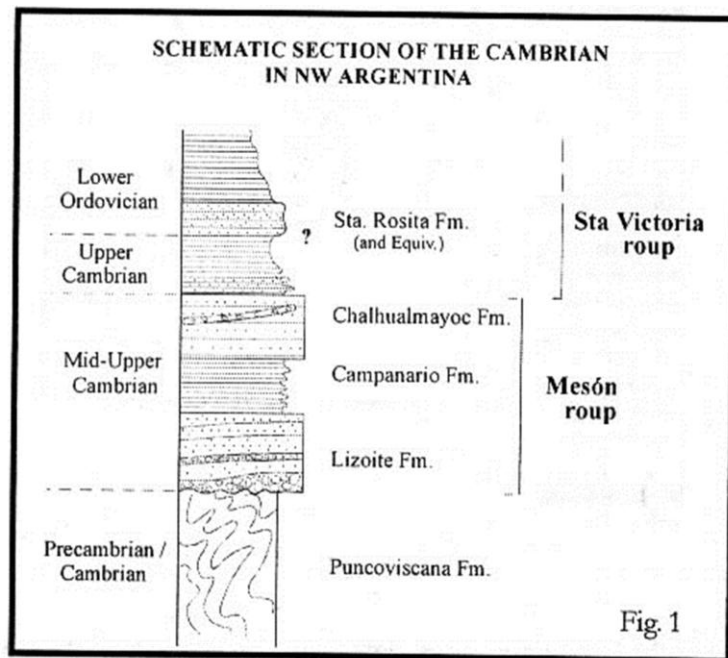
### The Early Cambrian

The precise Lower boundary of the Cambrian System it is not well known in the provinces of northwestern Argentina. It has been estimated to be included in the highly tectonized, dominantly clastic, thick sequences outcropping in the mentioned region. These rocks crop out with different formational names as Puncoviscana Formation s.l. Jujuy, Salta and Tucumán provinces), Suncho Formation (Catamarca Province) and Aguaditas/Negro Peinado Formations (La Rioja Province).

Lithologically they are represented by over 2000 meters of shales, slates, sandstones and quartzites with small participation of conglomerates, limestones and some interstratified basic lava and tuffs.

The sequence is highly deformed and fractured, with a general N-S alignment, fact that does not allows to find a complete undisturbed type section.

Paleoichnological studies allowed to recognize different levels with abundant trace fossils, being the only means of dating the earlier mentioned rocks. Among the recognizable Vendian trace fossils are: *Nereites saltensis*, *Tasmanadia* and probably *Sekwia*. Higher levels assigned to the Tommotian are characterized by: *Oldhamia radiata*, *O. flabellata*, *O. antiqua*, *Diplichnites* and *Dimorphichnus* among others (Aceñolaza and Durand, 1986; Aceñolaza *et al.*, 1999 with references).



Aceñolaza and Durand (1986) recognized a basin with a SW/NE alignment for the Vendian/ Tommotian. This basin was configured by an expansion of the gondwanan margin between the Rio de la Plata Craton (SE) and the Arequipa Massif (NT, both of a Rifean age (aprox 1000 My). This process was nominated as Pampean Cycle ("Ciclo Pampeano") or Pampean Orogeny (*sensu* Aceñolaza and Toselli,1981).

Jezek (1990) believes that this early Paleozoic basin had a smooth floor morphology, with large low gradient depositional fans developed towards the axis of the basin. Turbidites have been also recognized in this wide fans.

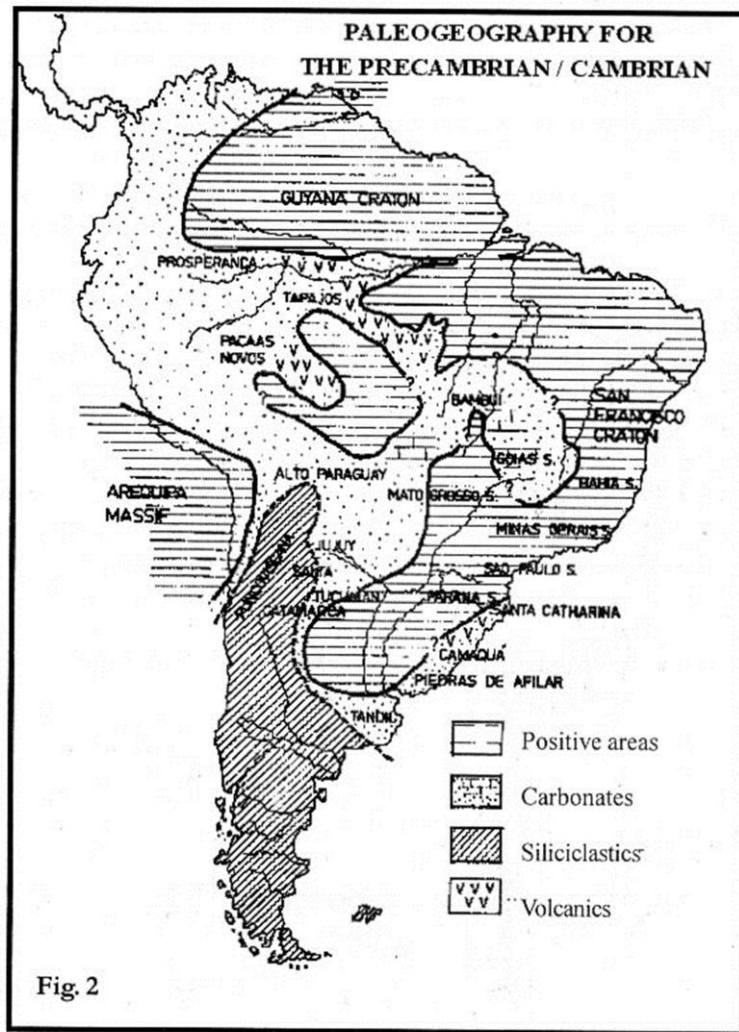


Fig. 2

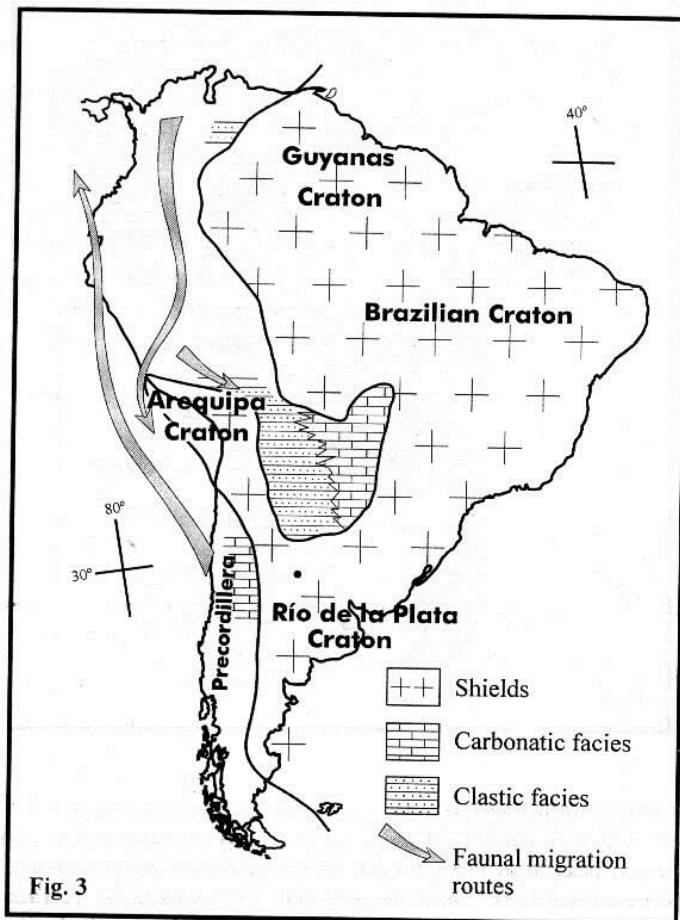
The sedimentary sequence also records post-tectonic granite intrusions of a Mid-Cambrian age (517 My) with important outcrops in Tastil and La Quesera localities (Salta Province). This orogenic episode gave place to an important deformative process of great magnitude, being followed by an erosive event named as "Tilcaric unconformity" or "Tilcaric phase" (Turner,1960). For Jezek (1990), the deformative process that affected Puncoviscana Formation had multiple phases:

The strongest phase occurred at the end of the Lower Cambrian (F1), a second one during the Ordovician and lastly by the Andean deformation (Cenozoic fracturation - F3).

### The Mesón Group

After the "Tilcaric" deformative and orogenic phase, a new basin was developed in Northwestern Argentina extending into Southern Bolivia. The sedimentation associated to this transgression is characterized by siliciclastic deposits of over 3000 m of thickness. They follow the Puncoviscana Formation (with an impressive angular unconformity - see cover picture of this volume -). Outcrops of this Formation are widely distributed in the northern provinces of Jujuy (Puna, Eastern and Subandean ranges), Salta (idem) and Tucumán (with the southernmost eastern outcrop at the Sierra del Campo).

Quartzites attributed to this sedimentary event have been also detected eastwards in perforations in the provinces of Santiago del Estero (Arbol Blanco), Chaco (Charata) and Formosa (Mariano Boedo).



The different tectonic elements that played the role of frame to this basin were not only the Rio de La Plata Craton and the Arequipa Craton, but also some structural highs of ageneral

SE/NW alignment ("Calchaquí Dorsal" *sensu* Auboin et al., 1973; or "Pampean Craton" *sensu* Bracaccini, 1960).

The development of this basin is related to the first flooding of the Andean border from Bolivia southwards, following a corridor that involved areas limited between the Arequipa Massif and the Guaporé Craton (SW margin of the Brazilian shield).

The sequence is dominated by sandstones and quartzites with hundreds of meters of thickness in some main depocenters (Santa Victoria, Salta), changing to some ten units in some marginal sectors of the same basin (eg. La Pedrera, Salta-stop Nr. 1 of the field trip-with 65.50 m *sensu* Sánchez,1994).

These rocks were unified by Turner (1960) under the name of Mesón Group, being represented by three formations clearly differentiated as follows from bottom to top: Lizoite, Campanario and Chalhuanayoc formations.

**Lizoite Formation:** White, pinkish and grayish quartzites and sandstones characterize lithologically this unit. This formation starts up after the Tilcarian unconformity with a conglomerate level. They show a fining upwards arrangement, and have been interpreted as subtidal sand-bars and channels (Sánchez,1999).

Westwards, in the Puna Region (in Potrerillos, Salta) Aceñolaza (1973) and Aceñolaza and Bordonaro (1989) recognized poorly preserved pieces of trilobites (*Asaphaiceus sp*) and trace fossils (*Cruziana sp*), but no further studies were done on them.

The thickness of this unit varies between 20 to 1,100 m.

**Campanario Formation:** Two members have been differentiated within this formation. a lower and sandier "green member", characterized by medium sandstones and quartzites, and an upper "dark purple member" with fine sandstones and subordinated quartzites. The Campanario Formation has been interpreted as intertidal flat sedimentation sporadically affected by storm events (Sánchez,1999).

Abundant trace fossils are recorded within the unit as well defined "pipe rocks" with *Skolithos* various type of *Rusophicus* and *Cruziana* among the most remarkable ones.

This Formation shows from 30 to 1,100 meters of thickness.

**Chalhuanayoc Formation:** Thickening upwards sequence of white to pinkish quartzites and subordinated sandstones with fewer interbedded fine conglomerates. Abundant trace fossils were recognized in the sequence (*Skolithos* very abundant- typical pipe rock occur - ).

Close to the upper part of this Formation, in the locality of Azul Pampa (Qujuy Province), a fauna that belongs to the *Parabolina (N.) frequens argentina* Biozone was also recognized. This unit is followed upwards transitionally by the Santa Rosita Formation (Santa Victoria Group) of a Cambro-Ordovician age.

## **Santa Victoria Group**

With this denomination is unified a few thousands of meters of shales, sandstones and quartzites of an Upper Cambrian -Lower Ordovician age outcropping in the northern Provinces of Jujuy and Salta. We have to mention that in certain sectors of the basin the stratigraphic relation between the Mesón and Santa Victoria groups presents an unconformity shown by a fine conglomerate level. The interpretation of the unconformity is varied, changing from a tectonic origin (uplift) to eustatic variations. Further discussion will take place in the field.

The Lower unit of this Santa Victoria Group is named as Santa Rosita Formation, and is the one that includes the Cambrian-Ordovician boundary. Lithologically is represented by shales and sandstones with subordinated quartzites of grayish, greenish and black colors, with a thickness of a few hundred meters. Biostratigraphically, the limit between the two systems is tied in the lower part of the Santa Rosita formation, with conodonts (*Iapetognathus* - *Cordylodus*), graptolites (*Rhabdinopora*) and trilobites (*Jujuyaspis*).

## **References**

-See references for field trip-