

A decorative graphic consisting of a series of vertical bars of varying heights and colors, transitioning from yellow to light blue to dark blue.

Uranium Mining Activities in Los Gigantes, Argentina: Possible Case Study Site

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PRAMU: Project of Environmental Restitution of Uranium Mining Activities

- Article 41. National Constitution of Argentina.
- National Law 24804. Nuclear Energy
- National Law 25018. Management of Radioactive Waste. Article 10 (J) management of waste coming from uranium mining activities. Article 11, environmental restitution of affected sites.
- National and Provincial regulations related to environment, mining and management of water resources.





THE SITE

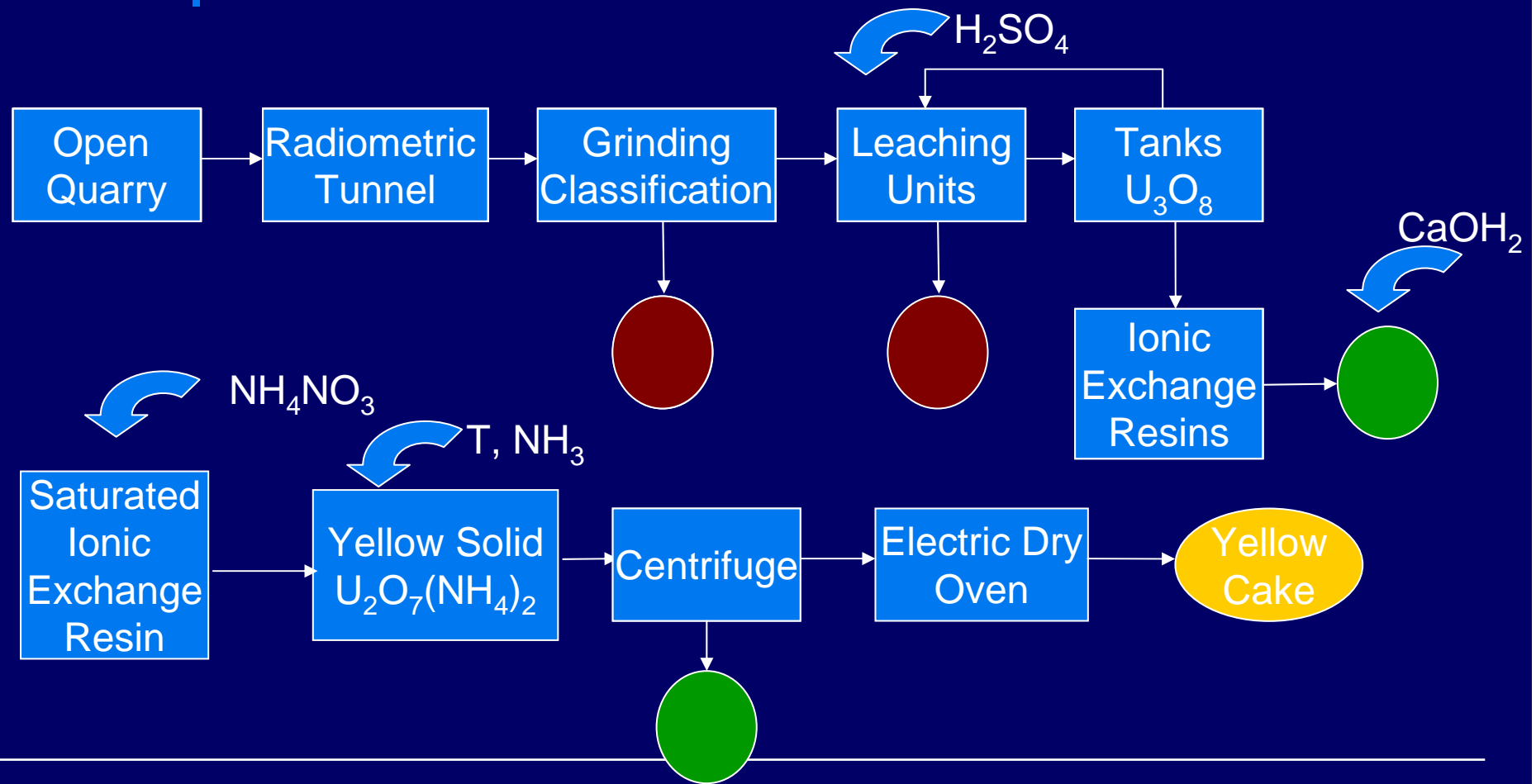
- ❑ The uranium mining facility of Los Gigantes is located in Sierra Grande (30 km of the city of Villa Carlos Paz, and remained operational till 1990.
- ❑ 1957 Detection of uranium minerals
- ❑ 1970 Detailed Prospecting Studies
- ❑ 1979 Awarding of the mining production to a private company
- ❑ 206 tn of concentrated U produced



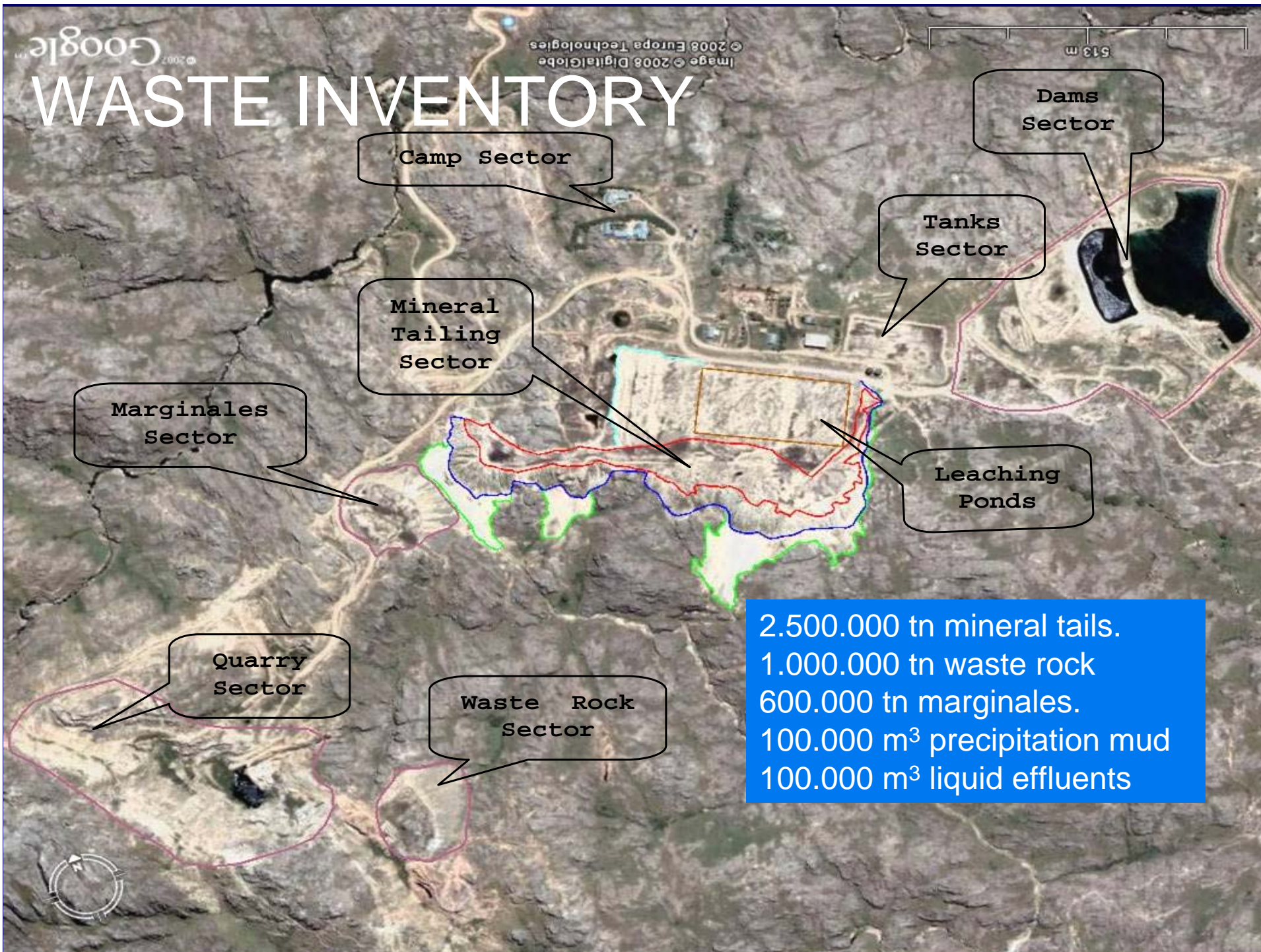
THE SITE

- ❑ 2500000 tn of mineral processed (0,15 ‰ U_3O_8 tcf, 0,239 ‰ U_3O_8 mean law, 0,123 ‰ U_3O_8 for marginal mineral)
- ❑ Open Quarry (500 m length, 10 m high)
- ❑ Grinding and classification of mineral by crushing to 4 inches
- ❑ Land owner: private
- ❑ Inside Provincial Water Reserve of Achala

Industrial Plant



WASTE INVENTORY



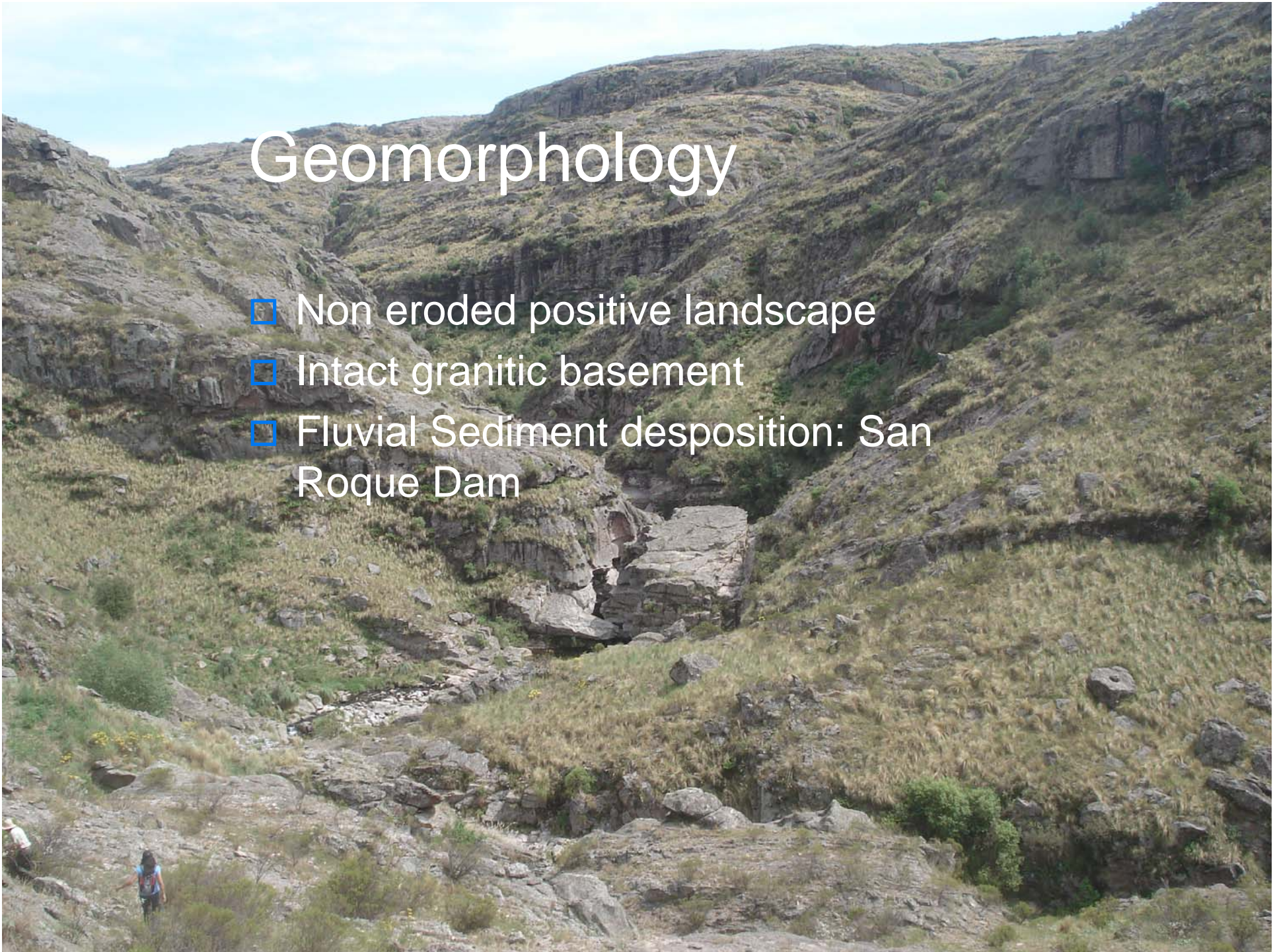
Morphology

- High Mountain plain associated to a tectonic step called La Mesada



Geomorphology

- ❑ Non eroded positive landscape
- ❑ Intact granitic basement
- ❑ Fluvial Sediment desposition: San Roque Dam





Hydrology - Climate

- ❑ Surface and subsurface water chemistry determined by the crystalline basement
- ❑ Water level: 2 phases (dry season from may to september; rain season from october to april).



Geology

- ❑ Igneous-metamorphic basement supporting sediments of different ages
- ❑ Plutonic rock composed of potassium feldspar, kaolin, quartz, sodium plagioclase, biotite, augite, **apatite and zircon with high uranium contents**, rutile
- ❑ Granite age: ~329-331 million years
- ❑ Two faults contribute to secondary permeability

Mineralization

□ Main minerals:

- Autunite $\text{Ca}(\text{UO}_2)_2 (\text{PO}_4)_2 \cdot 10-12 \text{H}_2\text{O}$ triclinic
- Metaautunite $\text{Ca}(\text{UO}_2)_2 (\text{PO}_4)_2 \cdot 2-6 \text{H}_2\text{O}$ triclinic

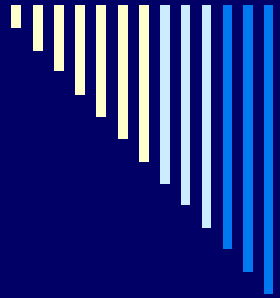
□ Secondary:

- $\text{Ca}(\text{UO}_2)_2 (\text{SiO}_3)_2 (\text{OH})_2 \cdot 5 \text{H}_2\text{O}$ monoclinic
- $\text{Ca}(\text{UO}_2)_4 (\text{PO}_4)_2 (\text{OH})_4 \cdot 7 \text{H}_2\text{O}$ rhombic

Hydrogeology



- ❑ No massive accumulation of meteoric water (positive landscape and crystalline basement)
- ❑ Faults are responsible of percolation and define recharge zones
- ❑ Low content of dissolved solids ($15 \mu\text{S cm}^{-1}$)



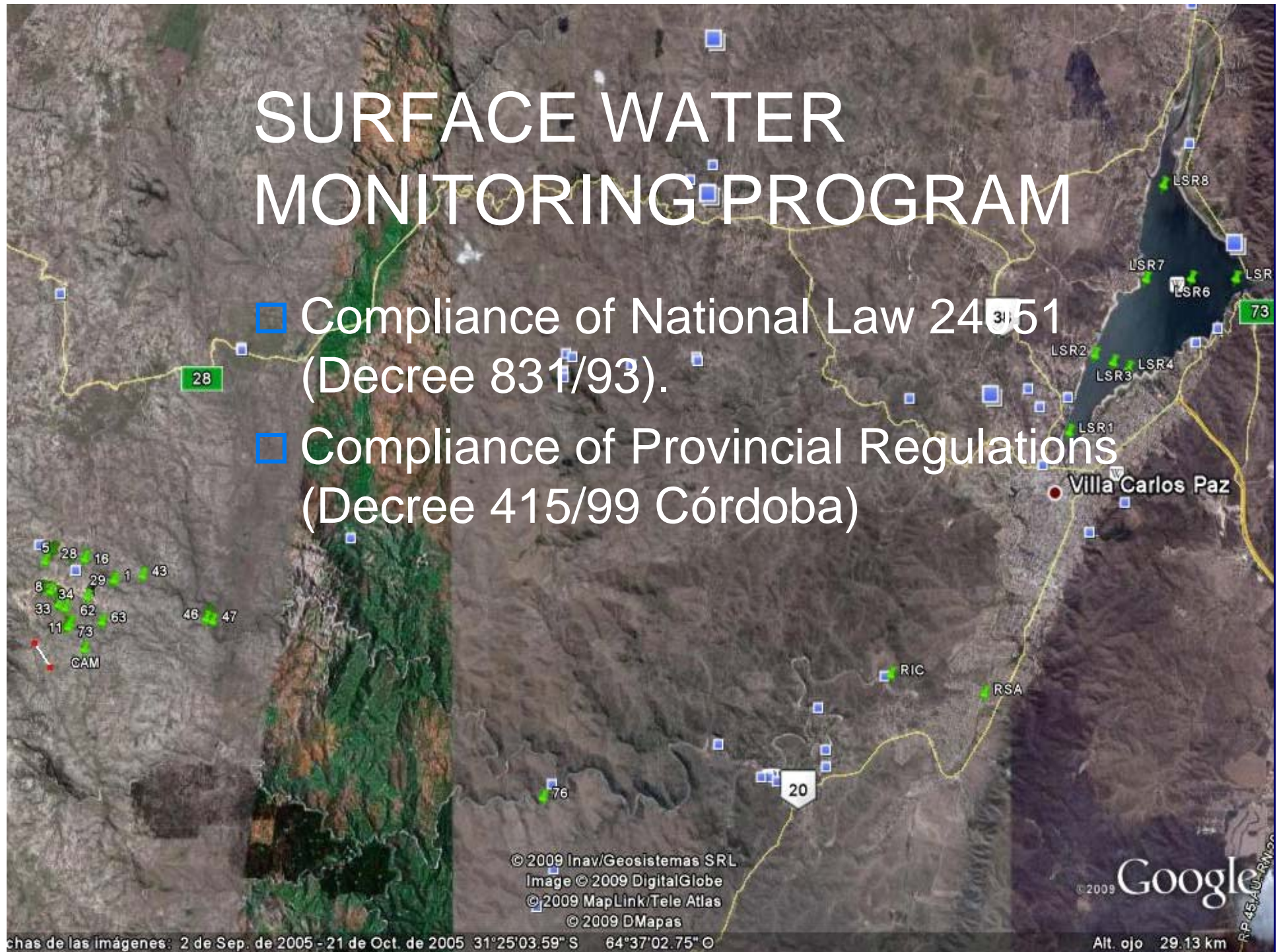
Geological Risk

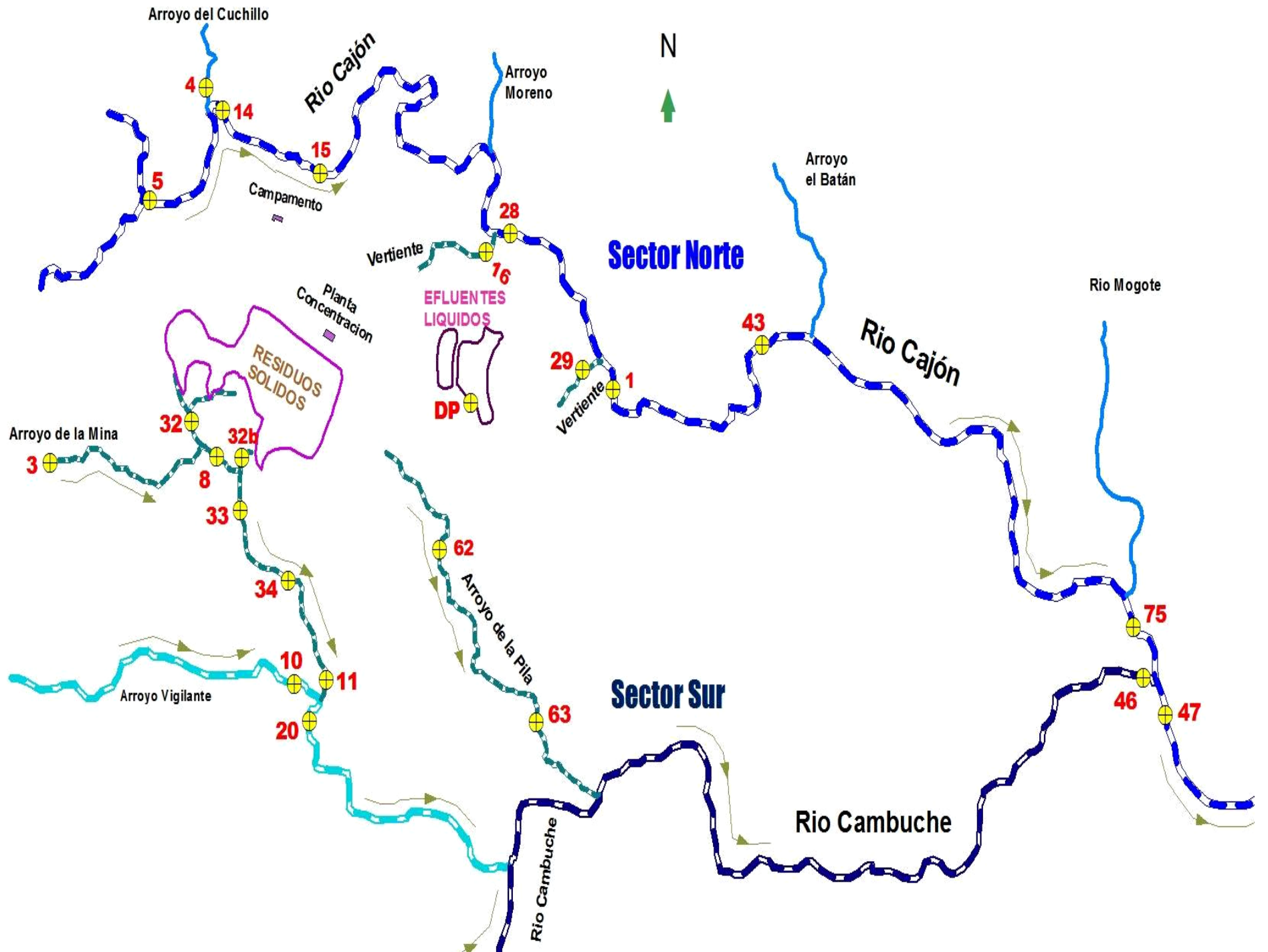
- Seismicity 1



SURFACE WATER MONITORING PROGRAM

- Compliance of National Law 24051 (Decree 831/93).
- Compliance of Provincial Regulations (Decree 415/99 Córdoba)





SUBSURFACE WATER MONITORING PROGRAM

- Compliance of National Law 24051 (Decree 831/93).
- Compliance of Provincial Regulations (Decree 415/99 Córdoba)



RADIOLOGICAL MONITORING PROGRAM

- Compliance of Norm AR 10.1.1
 - Activity ^{222}Rn in air
 - Equivalent dose rate
 - Surface contamination of materials, tools, clothing, etc.

^{222}Rn Monitoring Network

Google



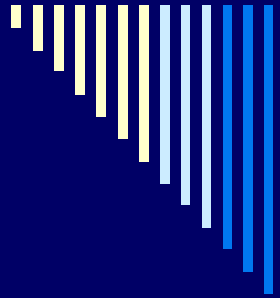
Points of Equivalent Dose Rate Assessment



DATA BASE

□ Includes:

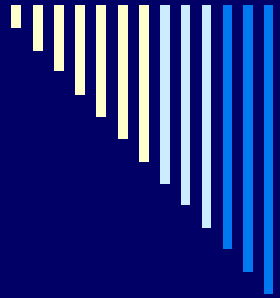
- Land use
 - Socioeconomical Aspects
 - Inventory and physicochemical characterization of the solid and liquid residues (tails, marginales, waste rock, precipitation muds, ponds)
 - Measurements of emanation, Rn in air and gamma radiation (tails, marginales, waste rock, precipitation muds, ponds)
-



DATA BASE

□ Includes:

- Physical Studies of soils (humidity, consistency, permeability, compactation, texture)
- Gamma Radiation base line measurements
- Water Cycle (10 years of rain, evaporation)



Data Base

□ Includes

- PhysicoChemical parameters of surface and subsurface waters
- Flow volume
- Regulations (discharges, allowed values, reference values for aquatic life protection)
- Main Impacts
- Mitigation Actions



Thank you!