



World Groundwater Congress  
IAH 2024 Davos

Groundwater and mining in the Atacama Desert:  
Impacts of the new Chilean Legislation and challenges for the future

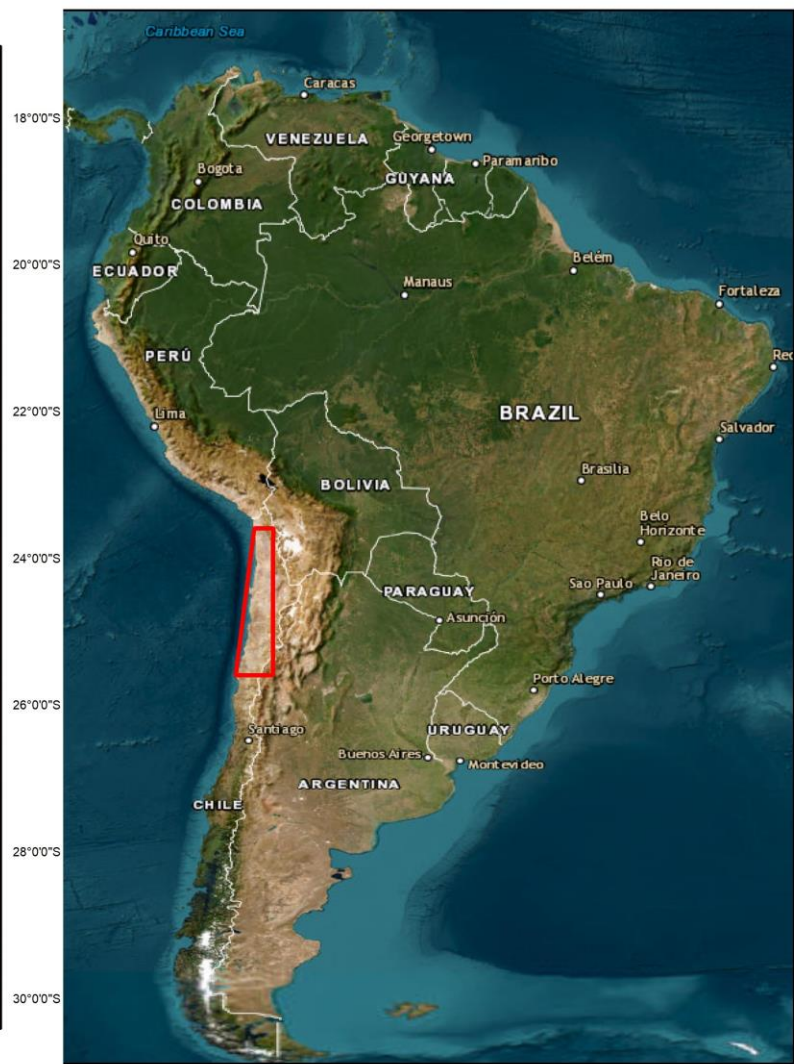
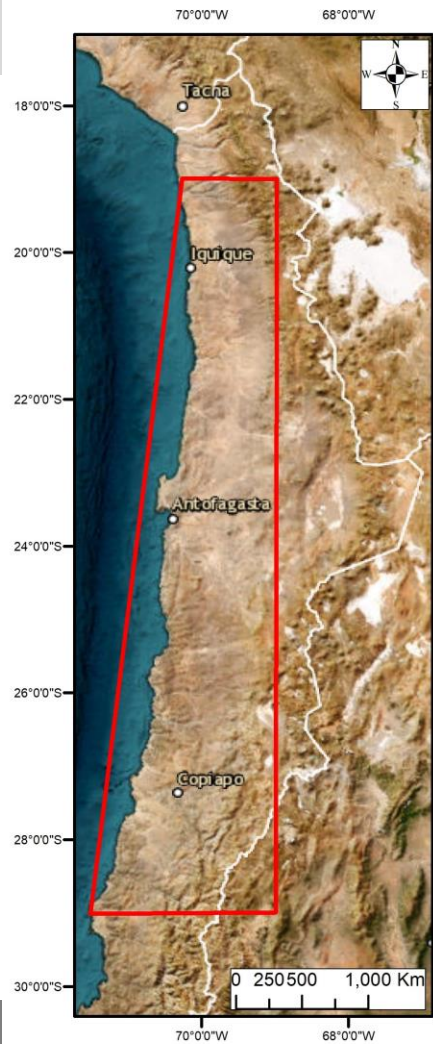
Tiaren García-Pérez and Beatriz Labarca, Hydrogeological Area

**Presenter:** Tiaren García-Perez ([tgarcía@srk.cl](mailto:tgarcía@srk.cl))

**Location:** Davos, Switzerland, 12-09-2024

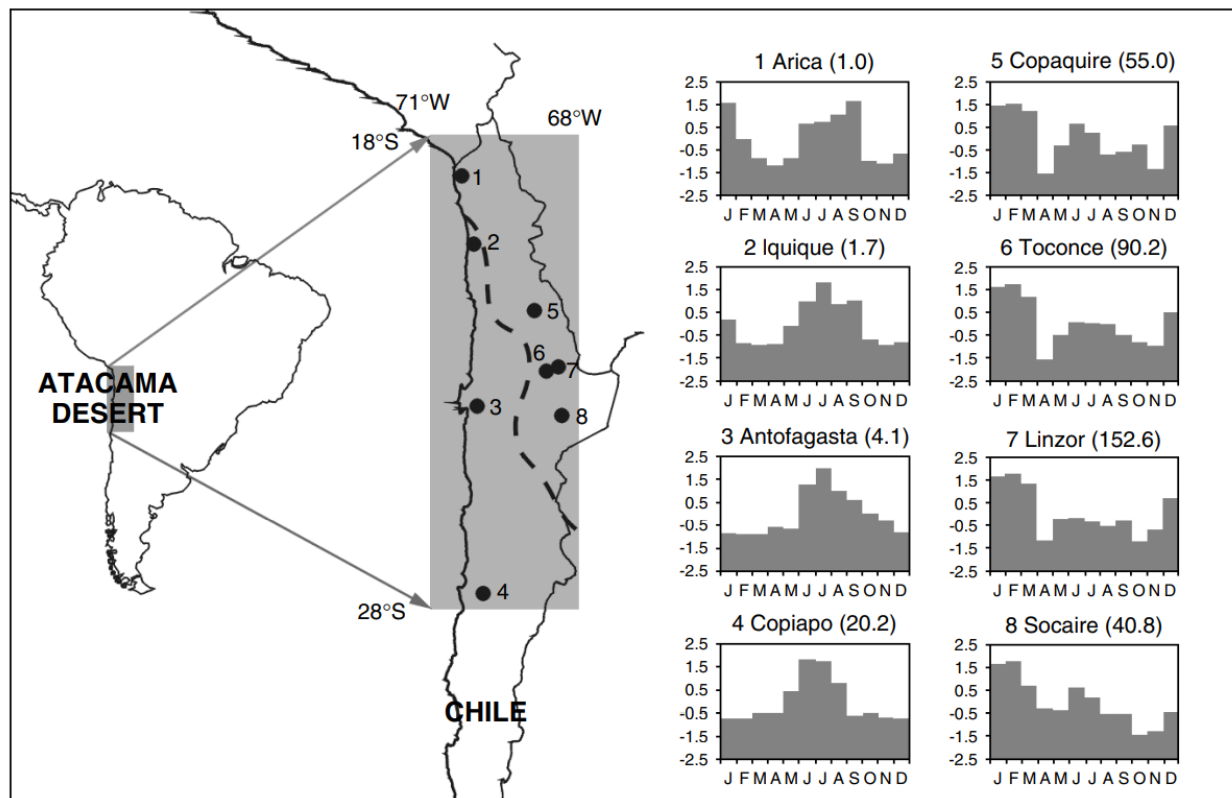


# The Atacama Desert



# The Atacama Desert

- The driest place on Earth
- Precipitation
  - 300 mm/yr at 5000 m a.s.l.
  - < 20 mm/yr at 2300 m a.s.l.
  - Below 2300 m a.s.l. “hyper-aridity” region < 1 mm/yr

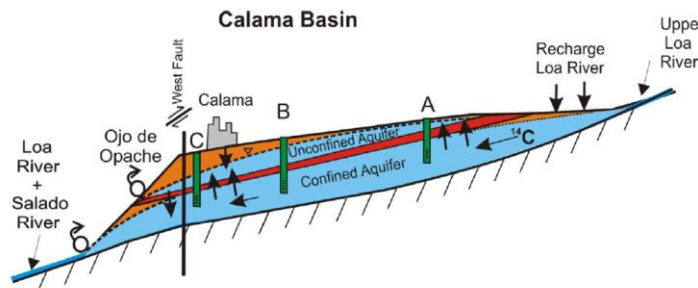


From Houston, J. (2006). Variability of precipitation in the Atacama Desert: its causes and hydrological impact

# Groundwater in the Atacama Desert

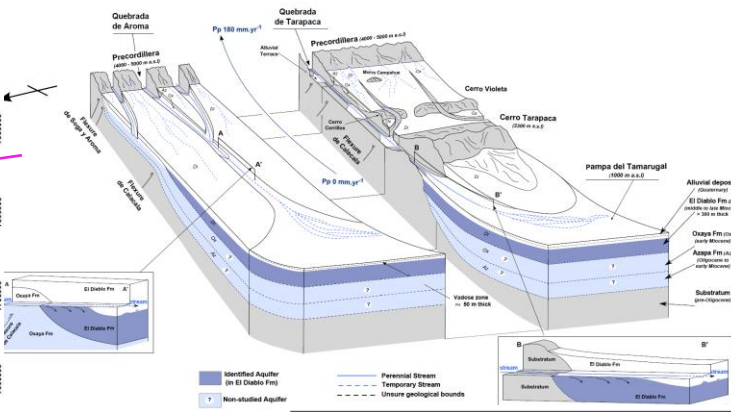
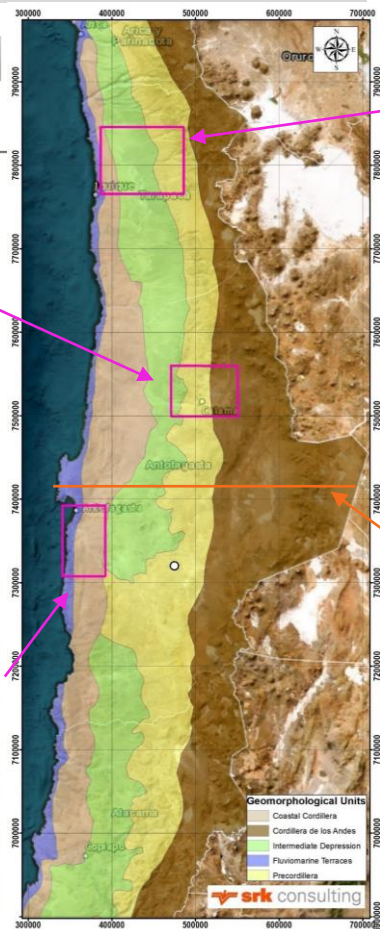
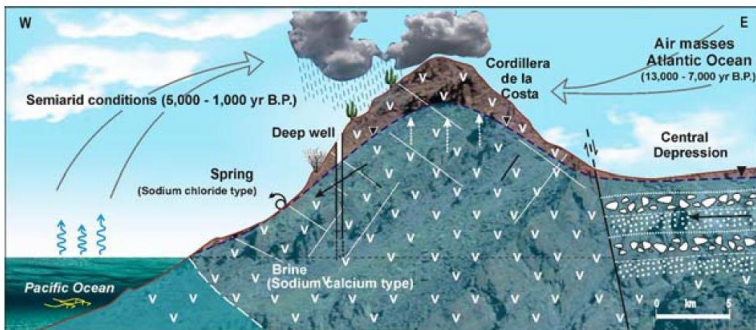
Recharge and residence times of groundwater in hyper arid areas: The confined aquifer of Calama, Loa River Basin, Atacama Desert, Chile

Christian Herrera<sup>a,\*</sup>, Linda Godfrey<sup>b</sup>, Javier Urrutia<sup>c</sup>, Emilio Custodio<sup>d</sup>, Teresa Jordan<sup>e</sup>, Jorge Jódar<sup>f</sup>, Katherine Delgado<sup>a</sup>, Fabiola Barrenechea<sup>g</sup>



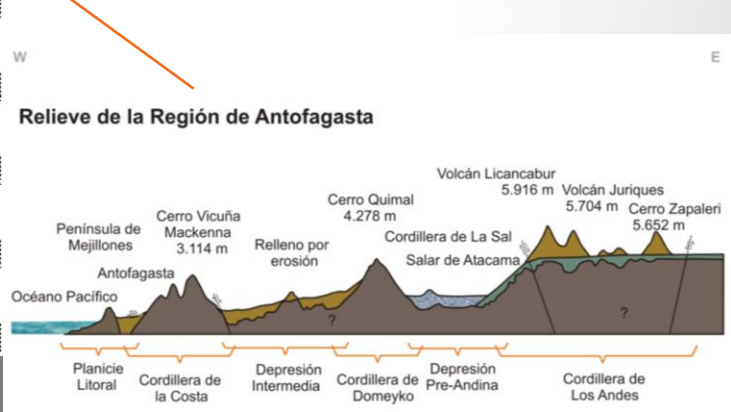
Groundwater origin and recharge in the hyperarid Cordillera de la Costa, Atacama Desert, northern Chile

Christian Herrera<sup>a,b,\*</sup>, Carolina Gamboa<sup>a,b</sup>, Emilio Custodio<sup>c</sup>, Teresa Jordan<sup>d</sup>, Linda Godfrey<sup>e</sup>, Jorge Jódar<sup>f</sup>, José A. Luque<sup>a,b</sup>, Jimmy Vargas<sup>g</sup>, Alberto Sáez<sup>h</sup>



Multidisciplinary study for the assessment of the geometry, boundaries and preferential recharge zones of an overexploited aquifer in the Atacama Desert (Pampa del Tamarugal, Northern Chile)

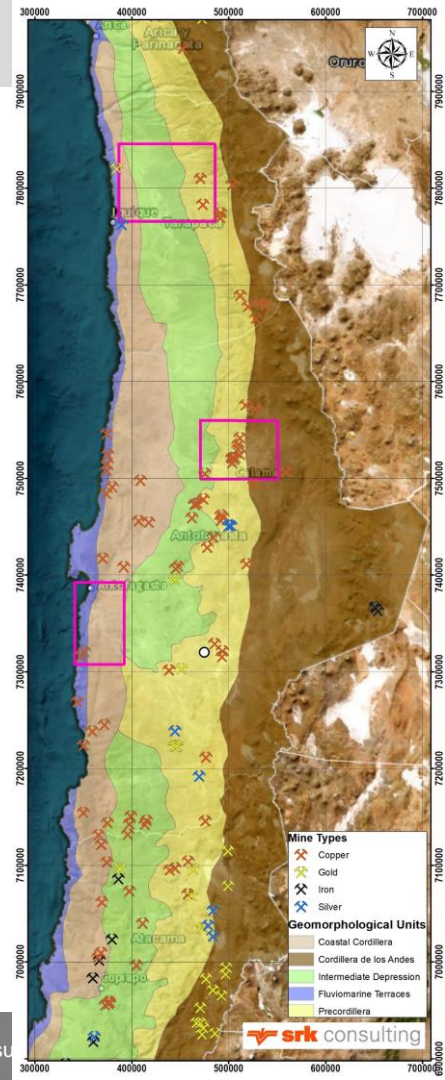
Benoît Viguerie<sup>a,\*,§</sup>, Hervé Jourde<sup>a</sup>, Gonzalo Yáñez<sup>b,c,d</sup>, Elias S. Lira<sup>a,b</sup>, Véronique Leonardi<sup>a</sup>, Claudia E. Moya<sup>a,f,g</sup>, Tiaren García-Pérez<sup>b</sup>, José Marínique<sup>b</sup>, Elisabeth Lictevet<sup>a,h</sup>



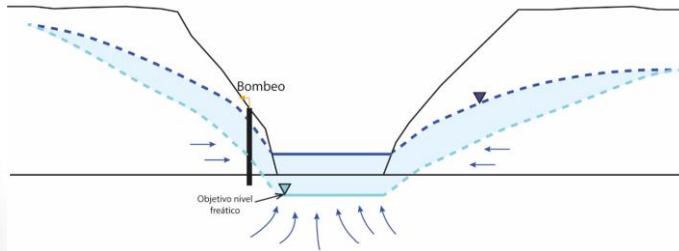
# Mining in the Atacama Desert

Mineral Type	Chilean Production (TM)	World Participation	Ranking	World Reserves
Copper	5.251 kTM	24%	1	19%
Gold	37 TM	1%	>15	7%
Silver	1.378 TM	5%	7	4%
Iron	11 MTM	27%	2	34%

- Production for 2023. Data from USGS, Sernageomin and Cochilco
- Mostly open-pit mines.
- (Lithium mining is also being developed in this zone).



- Mining excavation exposes the GW level
- Water in fractured media
- Water drainage: Safety and economical purposes
  - Slope stability / Pore pressure control
  - Less use of wet explosives



- In open pit mining, once the groundwater level is encountered, to control the pore pressure and water in the pit, mine drainage must be implemented.
- According to Chilean Legislation, before 2023, all the water inflows “encountered” in the mine could be use without control.

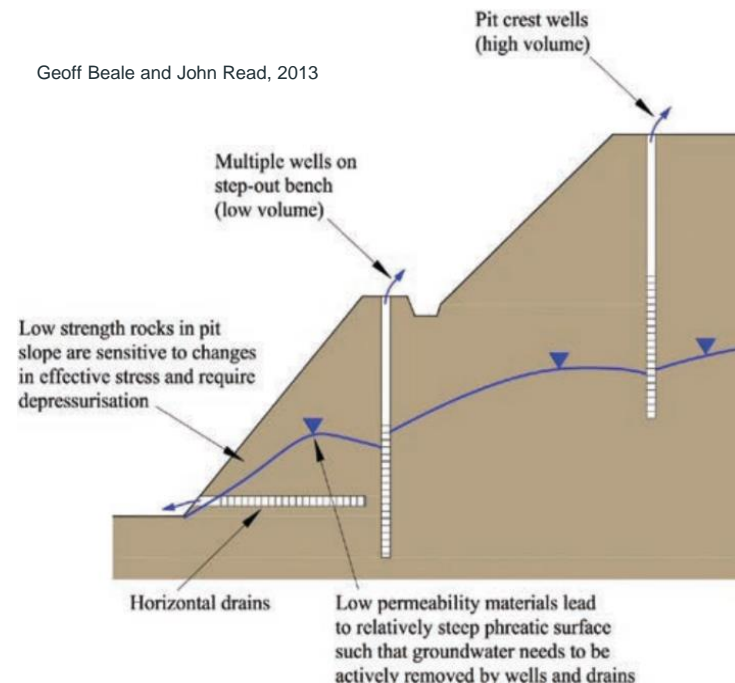
En efecto, el artículo 110 del Código de Minería establece:

“El titular de concesión minera tiene, por el solo ministerio de la ley, el derecho de aprovechamiento de las aguas halladas en las labores de su concesión, en la medida en que tales aguas sean necesarias para los trabajos de exploración, de explotación y de beneficio que pueda realizar, según la especie de concesión de que se trate. Estos derechos son inseparables de la concesión minera y se extinguirán con ésta”.

Por su parte, el inciso segundo del artículo 56 del Código de Aguas señala:

“Corresponde a los dueños de pertenencias mineras, dentro de ellas, el derecho de aprovechamiento de las aguas halladas en sus labores, mientras conserven el dominio de sus pertenencias y en la medida necesaria para la respectiva explotación.”

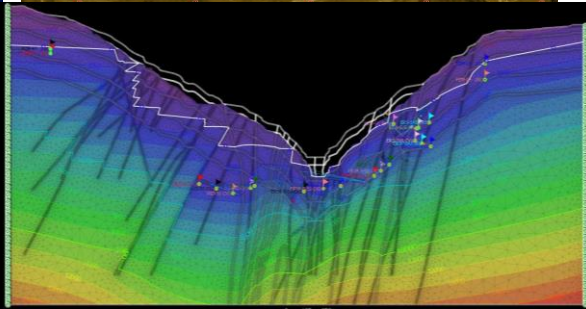
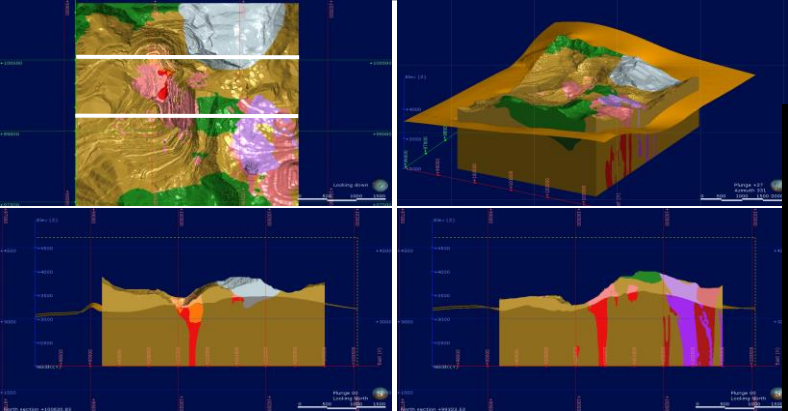
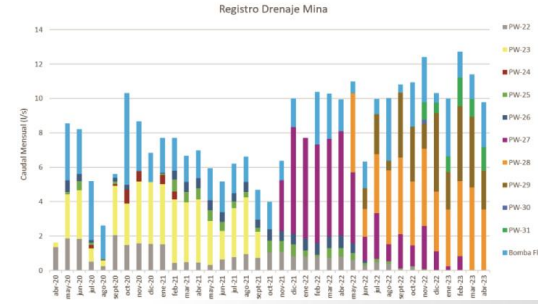
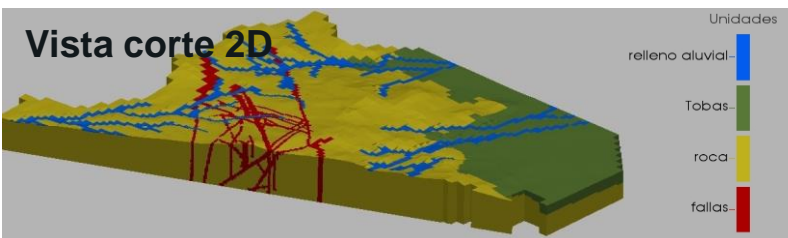
Geoff Beale and John Read, 2013



- ✓ Law N° 21.435 (06/04/2022), which reforms the Water Code (DFL N° 1.122/1981), incorporating in a new article the repealed subsection 2 of article 56 of the Water Code.
- ✓ Resolution (Exempt) DGA N° 2600 (17/10/2022), which establishes the scope and applicability of Article 56 bis of the Water Code.
- ✓ Resolution (Exempt) DGA N° 2682 (21/10/2022), which determines the forms, requirements and periodicity with which the information referred to in Article 56 bis of the Water Code must be provided.
- ✓ The information should delivered to the Water General Direction (DGA) must contain:
  - ✓ The **location of the operations(s)** to capture the encountered waters, indicating the commune, province and UTM coordinates according to the WGS 1984 Datum and the time zone. These works must be characterized in detail, indicating, among other information, their depth, typology and operation.
  - ✓ The **average and maximum flow rate and the total annual volume**, if applicable, expressed in volume per unit time (l/s, m3/s, or other unit).
  - ✓ The work within the exploitation sites **that justifies the need for the use of such water**, specifying its consumption, use or provision associated with these activities.
  - ✓ A **hydrogeological study** that establishes the origin and conceptual framework (**conceptual model**) of the hydrogeological functioning of the hydrogeological sector of common use where the waters are located and the influence it may have on adjacent sectors.

# Current Work

- All mines were required to deliver these documents in July of 2023
  - We wrote reports about pumping wells and dewatering systems
  - We built conceptual hydrogeological models
  - Each mine would have to report any change and new water encounters
- The authorities are reviewing the information and should define actions to follow for each mine





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Tiaren García-Pérez

