Groundwater residence times of the Salar de Coposa basin, North Chile

Preliminary results

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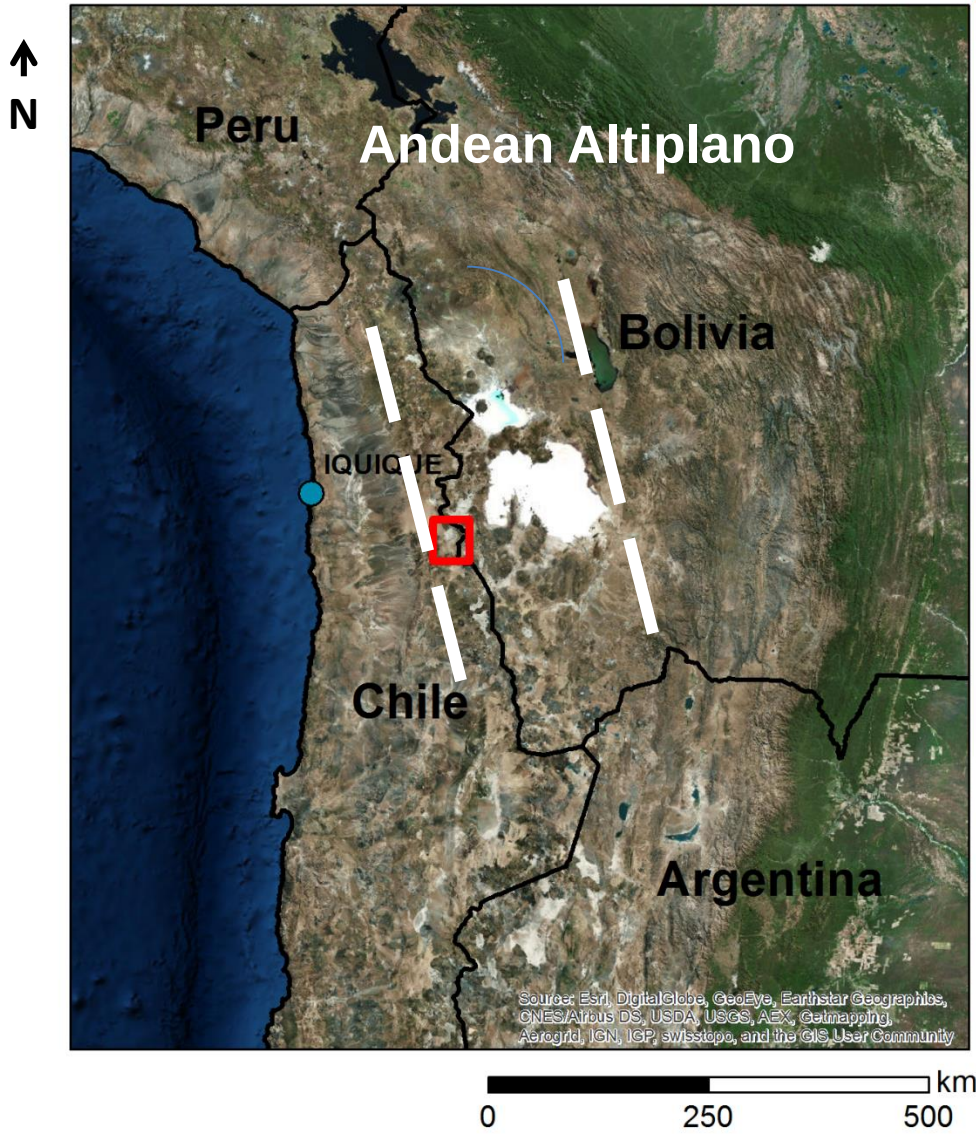
Insights

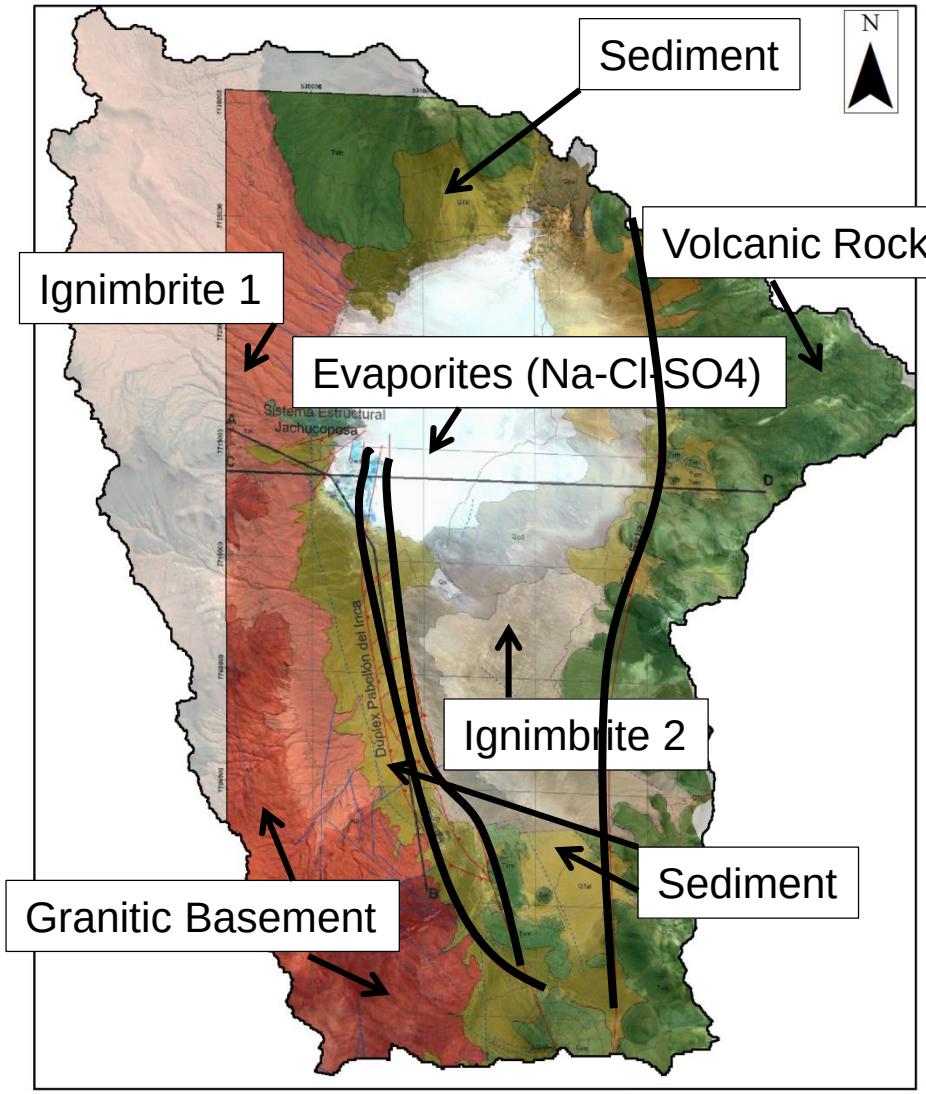
- Carbon chemistry (1/[DIC], d13C, 14C)
- Uncorrected and corrected mean residence times
- Understanding of hydrogeological and hydrochemical processes (typical semi-arid Andean Altiplano basin)

Background information

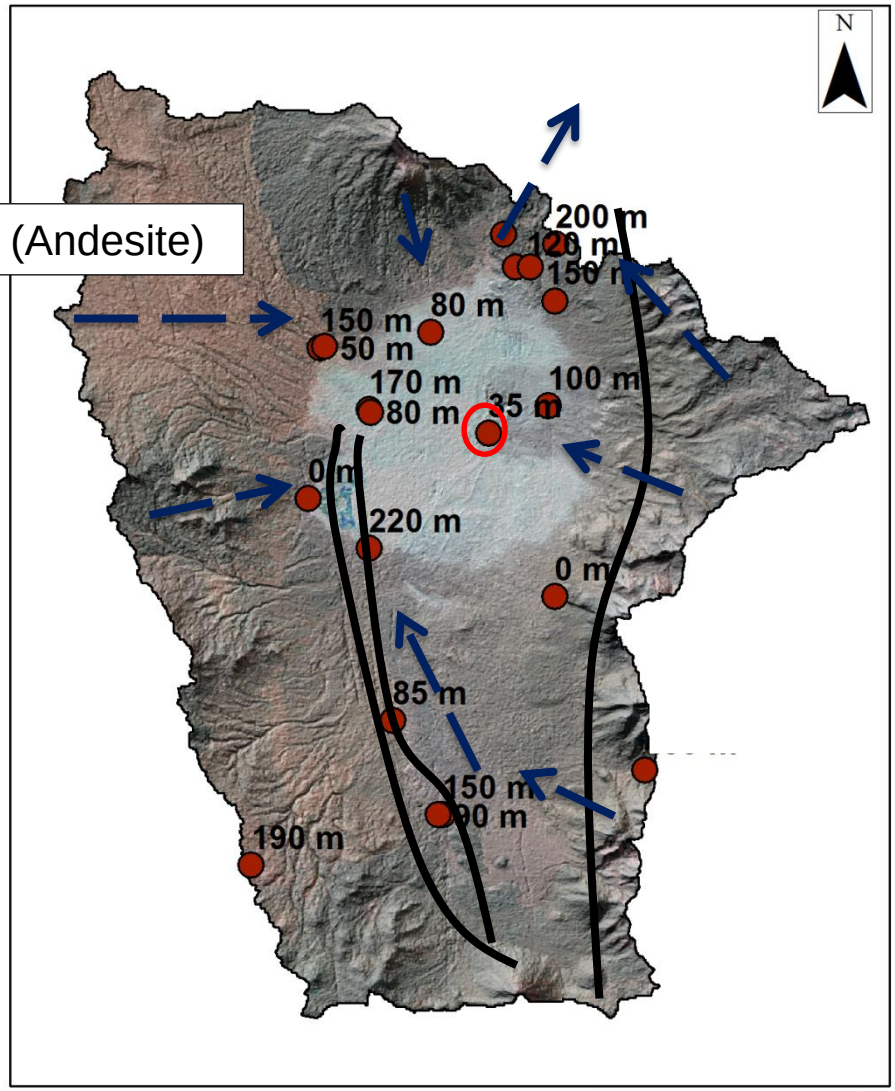
Study area location and topography



Geological setting and groundwater flow



Source: DICTUC, 2005



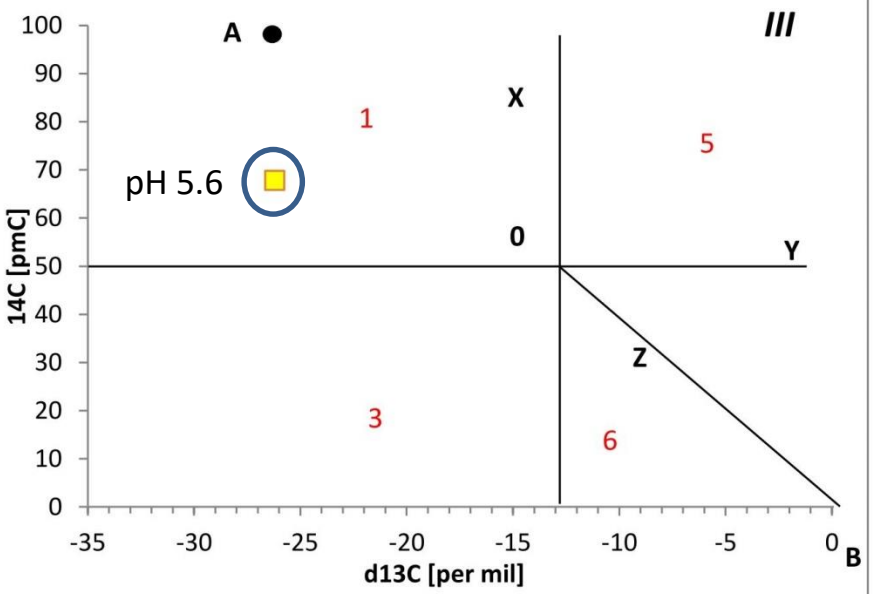
Carbon chemistry

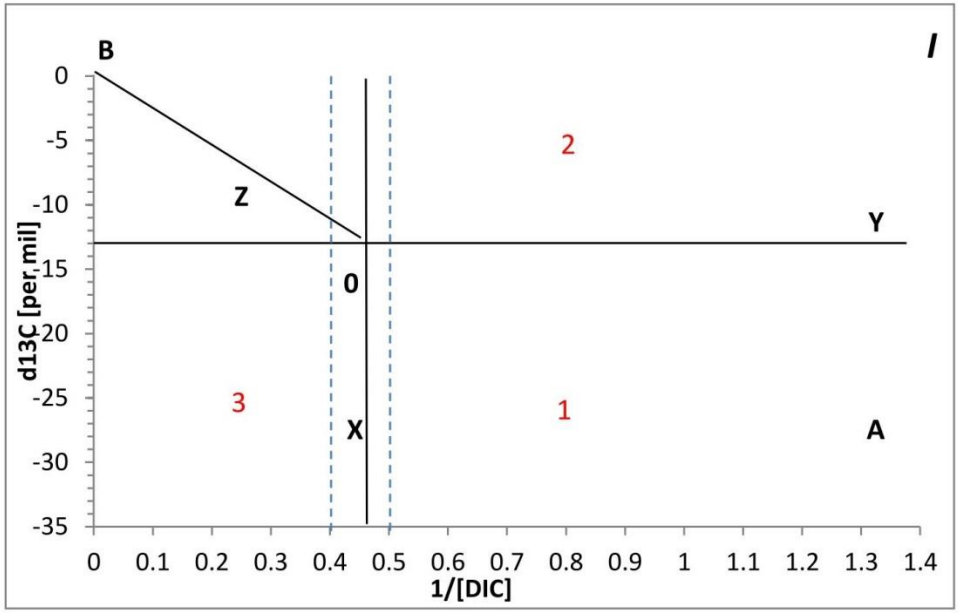
Carbon chemistry

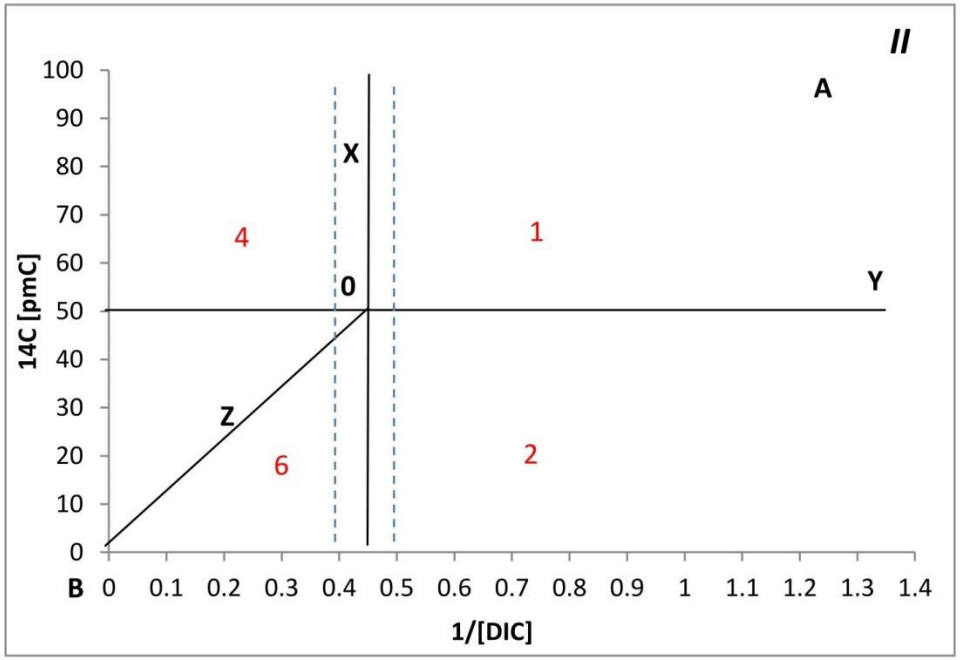
- Only soil carbon dissolved

Carbon system evaluation
after Han & Plummer 2012:

d13C soil CO_2 = -26 ‰
d13C calcite minerals = 0 ‰
14C calcite minerals = 0 pmC

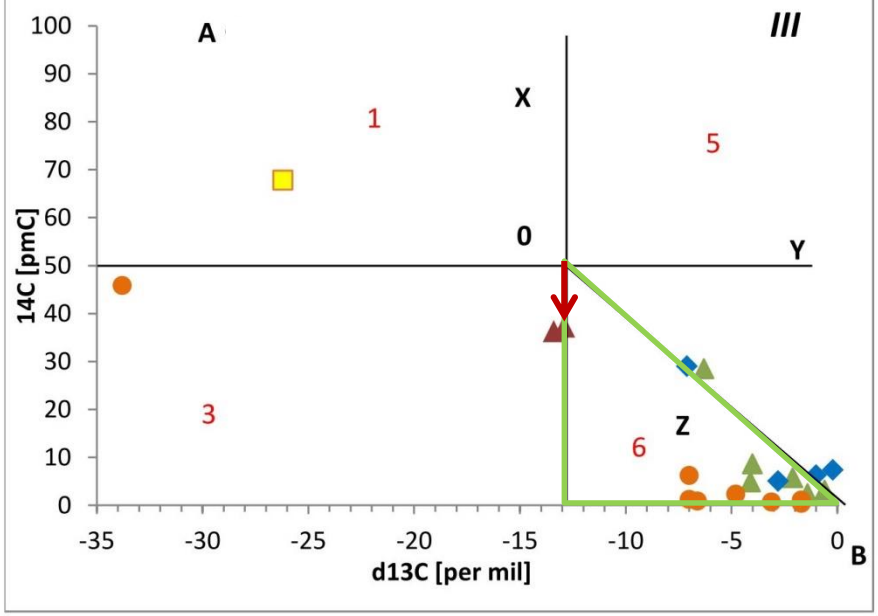




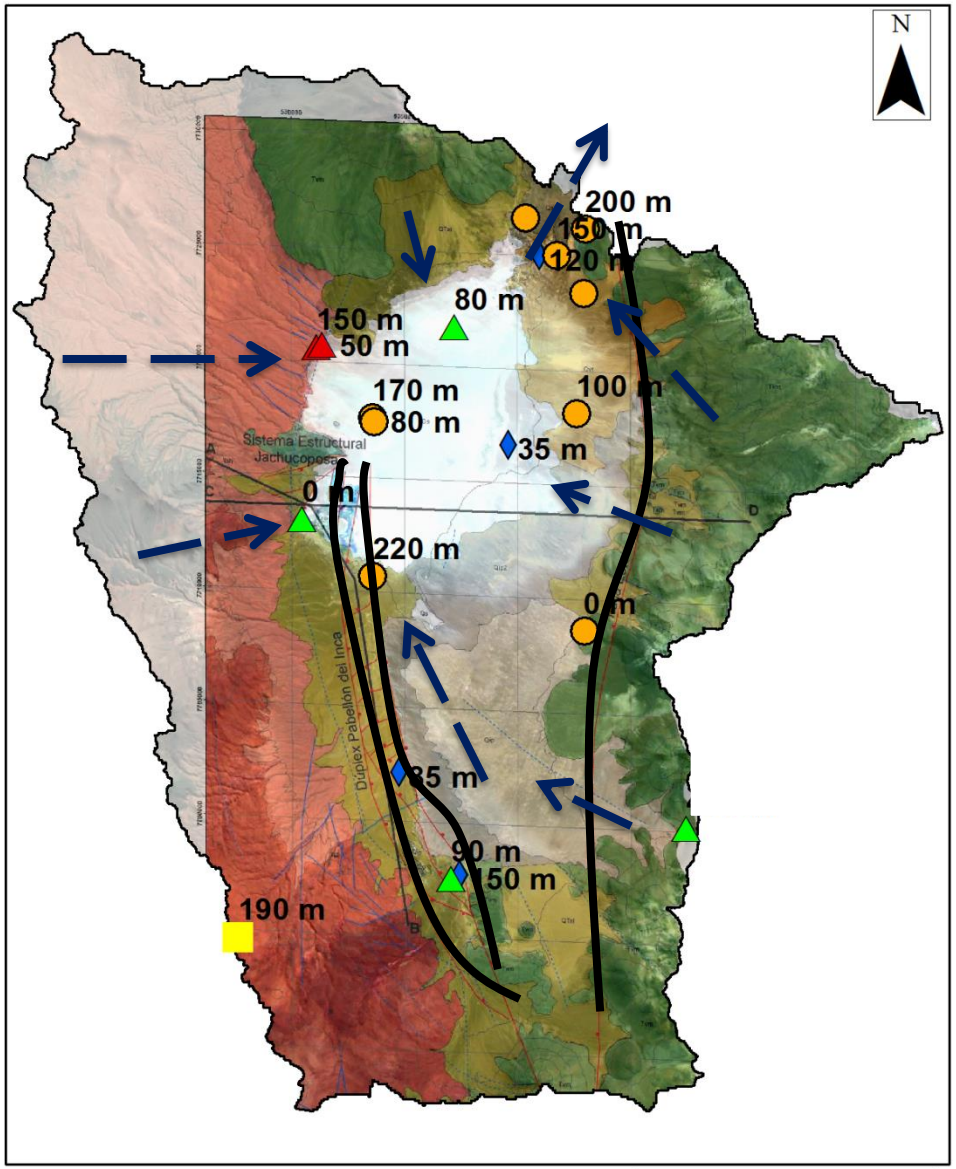


Carbon chemistry

- Only soil carbon dissolved
- Closed system conditions + 14C decay
- Caclite dissolution + isotope exchange + 14C decay
- Gypsum dissolution / Calcite precipitation / Dedolomitization
- Methanogenesis, old organics and/or geogenic CO_2

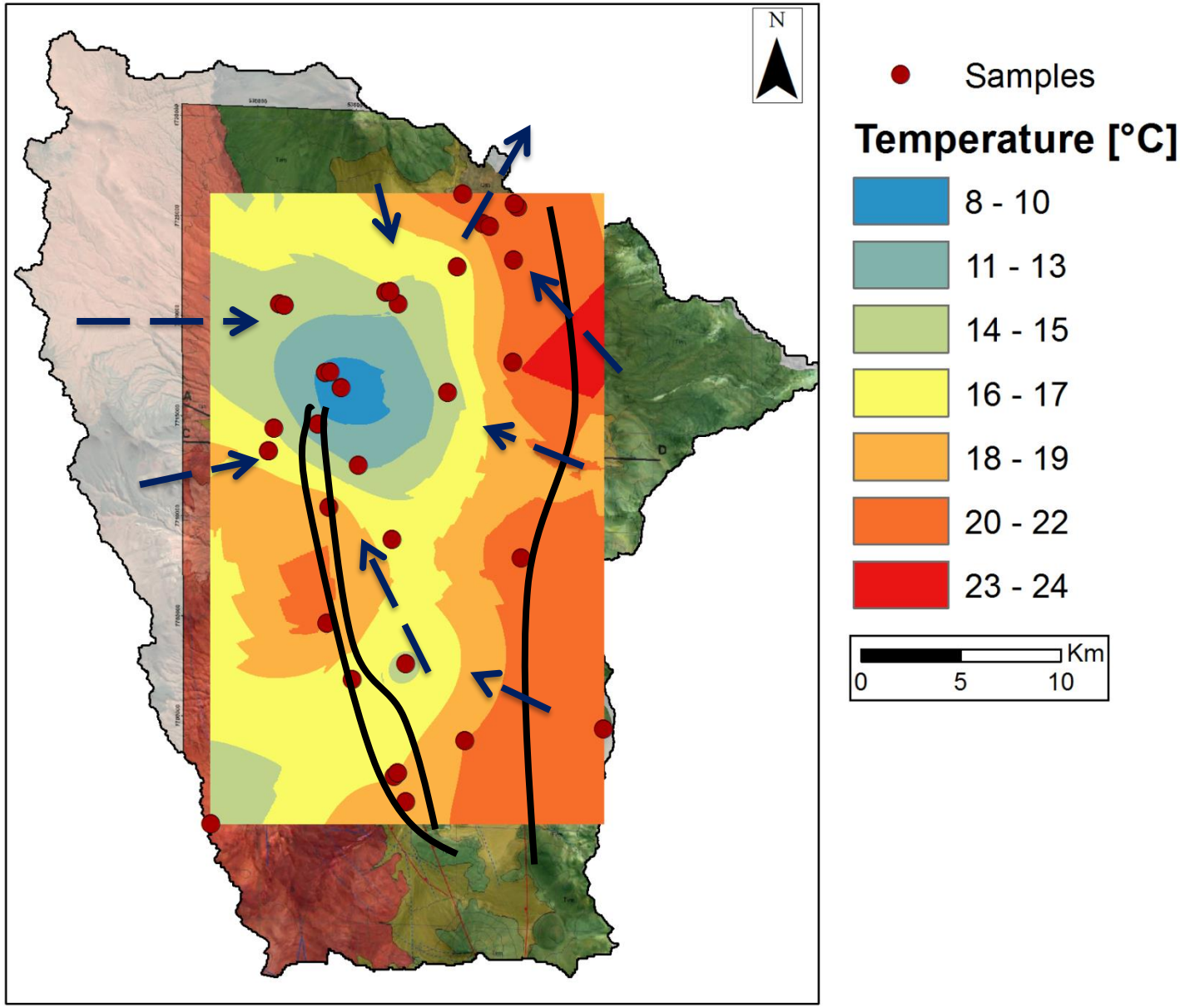


Carbon Chemistry - georeferenced



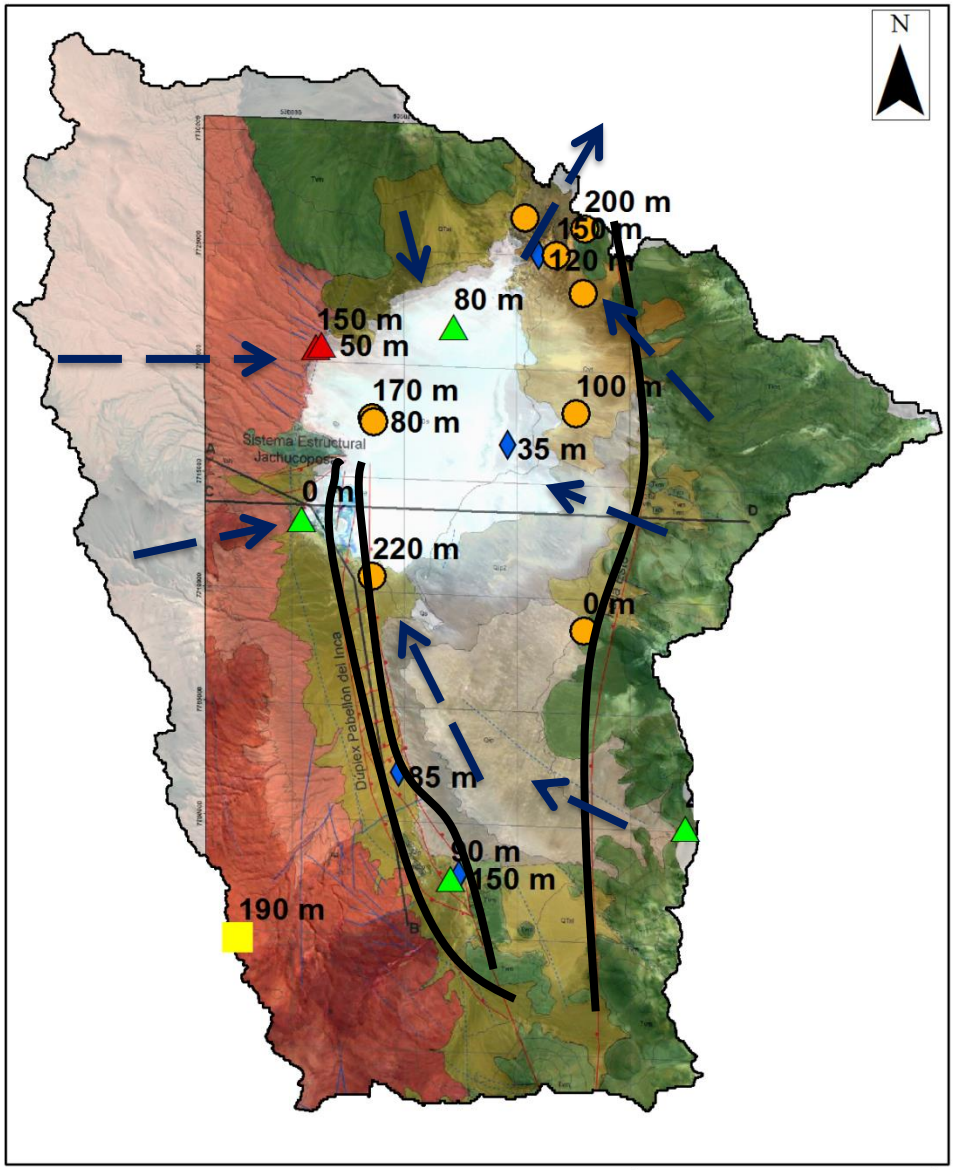
- Only soil carbon dissolved
- Closed system conditions + 14C decay
- Caclite dissolution + isotope exchange + 14C decay
- Gypsum dissolution / Calcite precipitation / Dedolomitization
- Other carbon source

Groundwater temperature anomalies



Mean residence times

Mean residence time correction



- Gypsum dissolution / Calcite precipitation / Dedolomitization
- Other carbon source

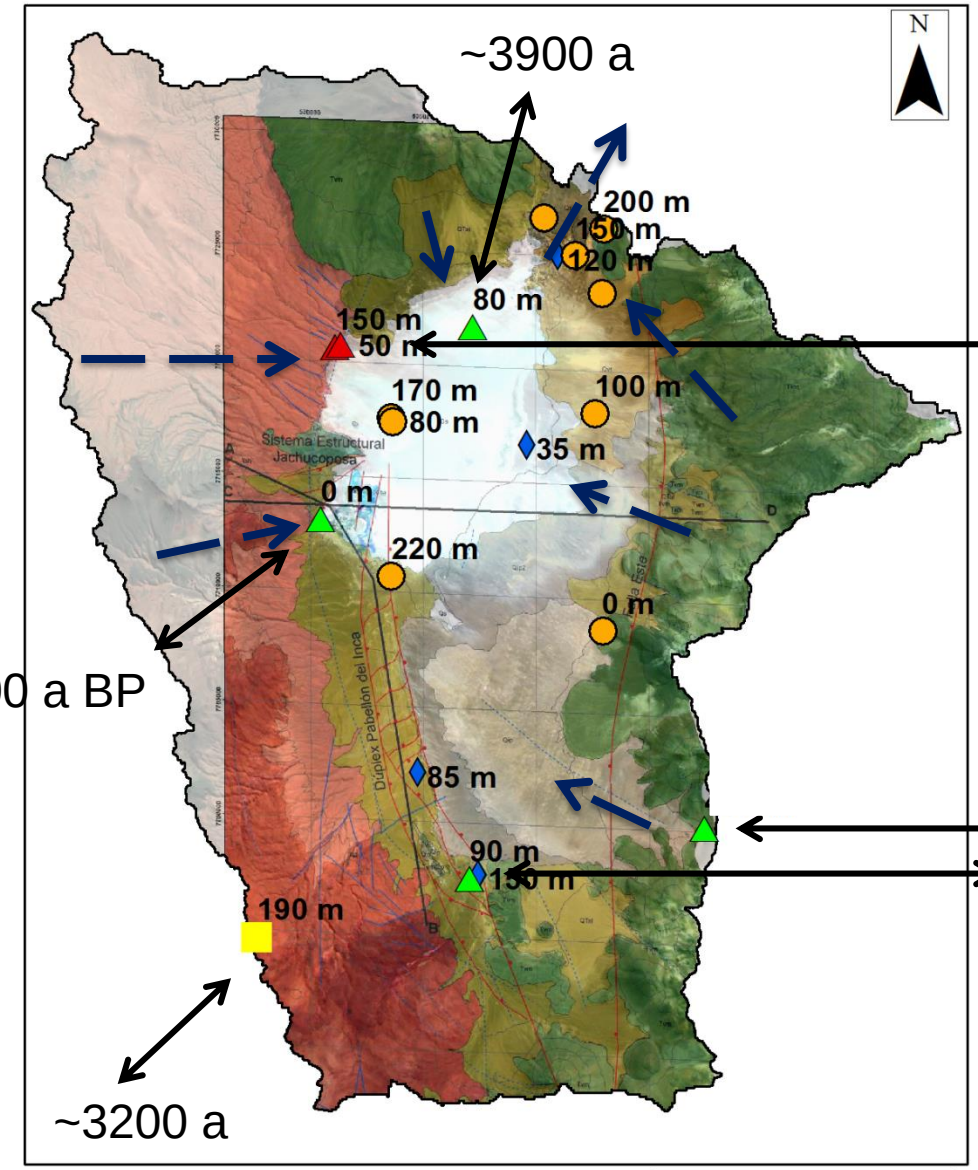
Uncorrected: 10,000 – 40,000 a BP

- Only soil carbon dissolved

- Closed system conditions + 14C decay
- Caclite dissolution + isotope exchange + 14C decay

Revised Fontes & Garnier Model
(Han & Plummer Model)

Corrected mean residence times



Multilevel observational well

0 m bgl

50 m bgl : ~2000 a BP

150 m bgl : ~2500 a BP

young > 50 a BP

young > 50 a BP

Conclusions

Conclusions

- Residence time correction based on 14C complicated affair
- Uncorrected ages usually highly overestimated
- Close to recharge areas young groundwater
- Renewal time of the spring related groundwater system: ~8400 a
- Around the salt plain recharged water arrive after 2000-4000 a
- Temperature anomalies indicate uprising of deeper groundwater along fault zones

Thank you

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Questions and Answers

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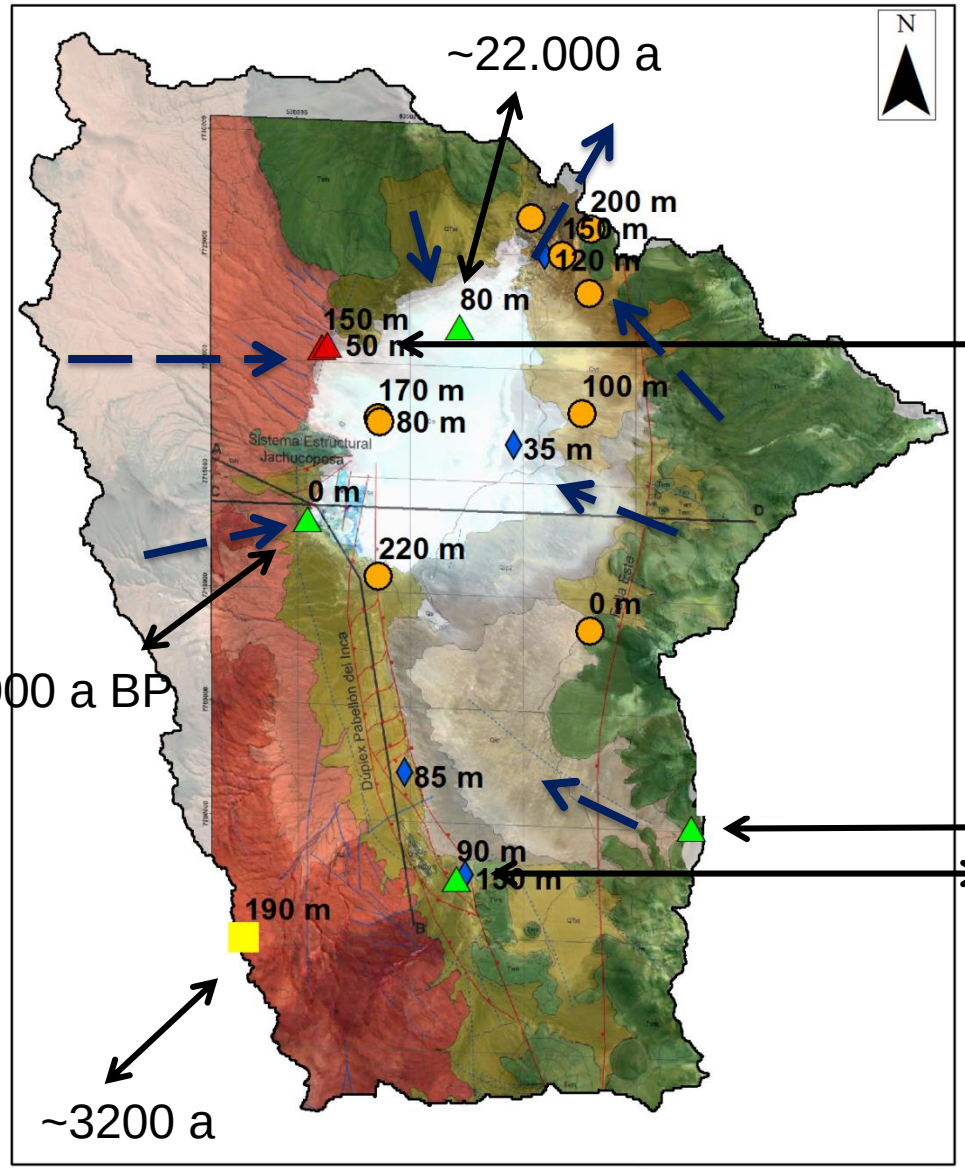
Uncorrected mean residence times



0 m bgl

50 m bgl : ~8100 a BP

150 m bgl : ~8400 a BP

young > 30.000 a BP

young > 10.000 a BP

Cross section location

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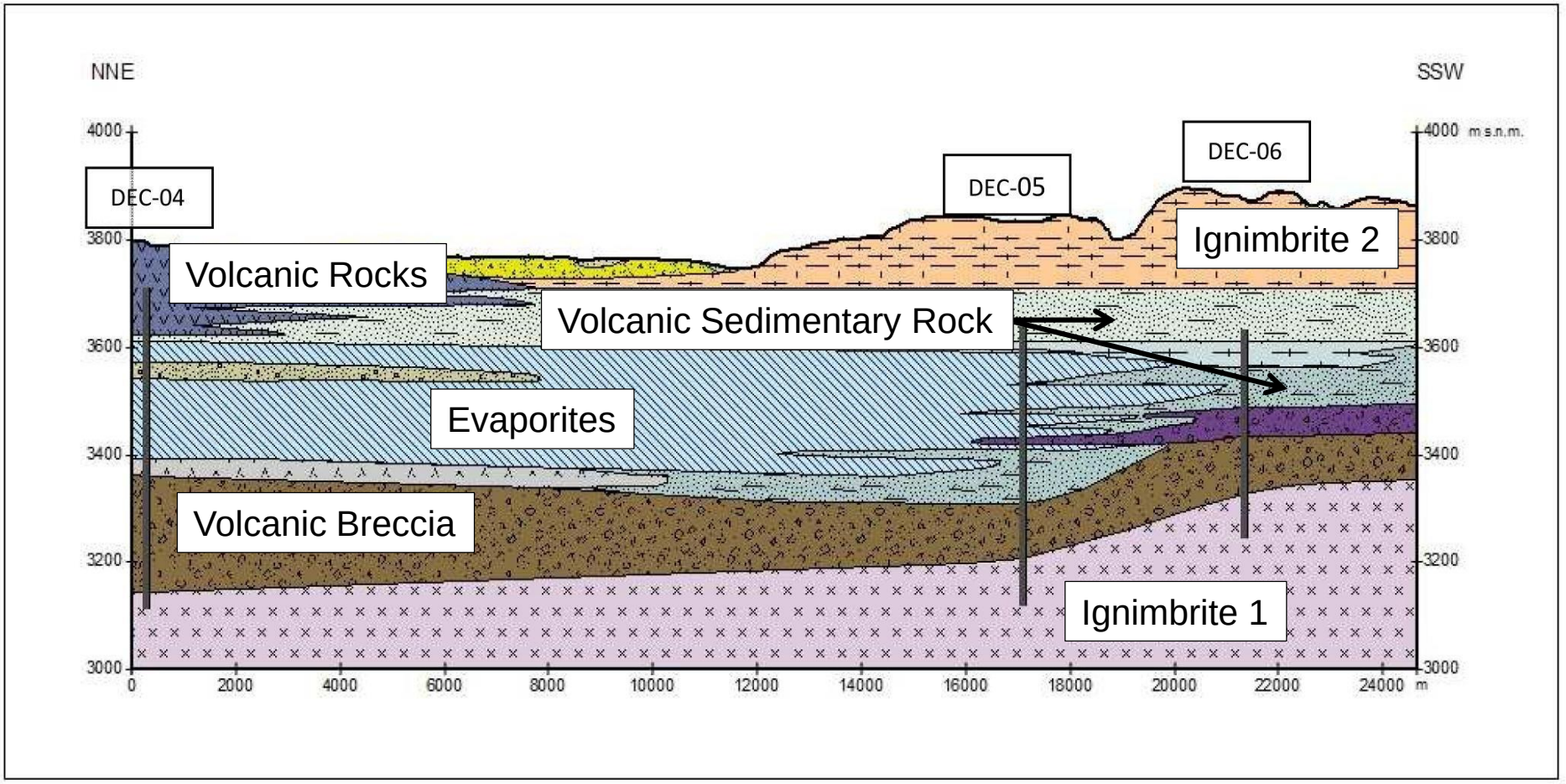
Schematic subsurface geology



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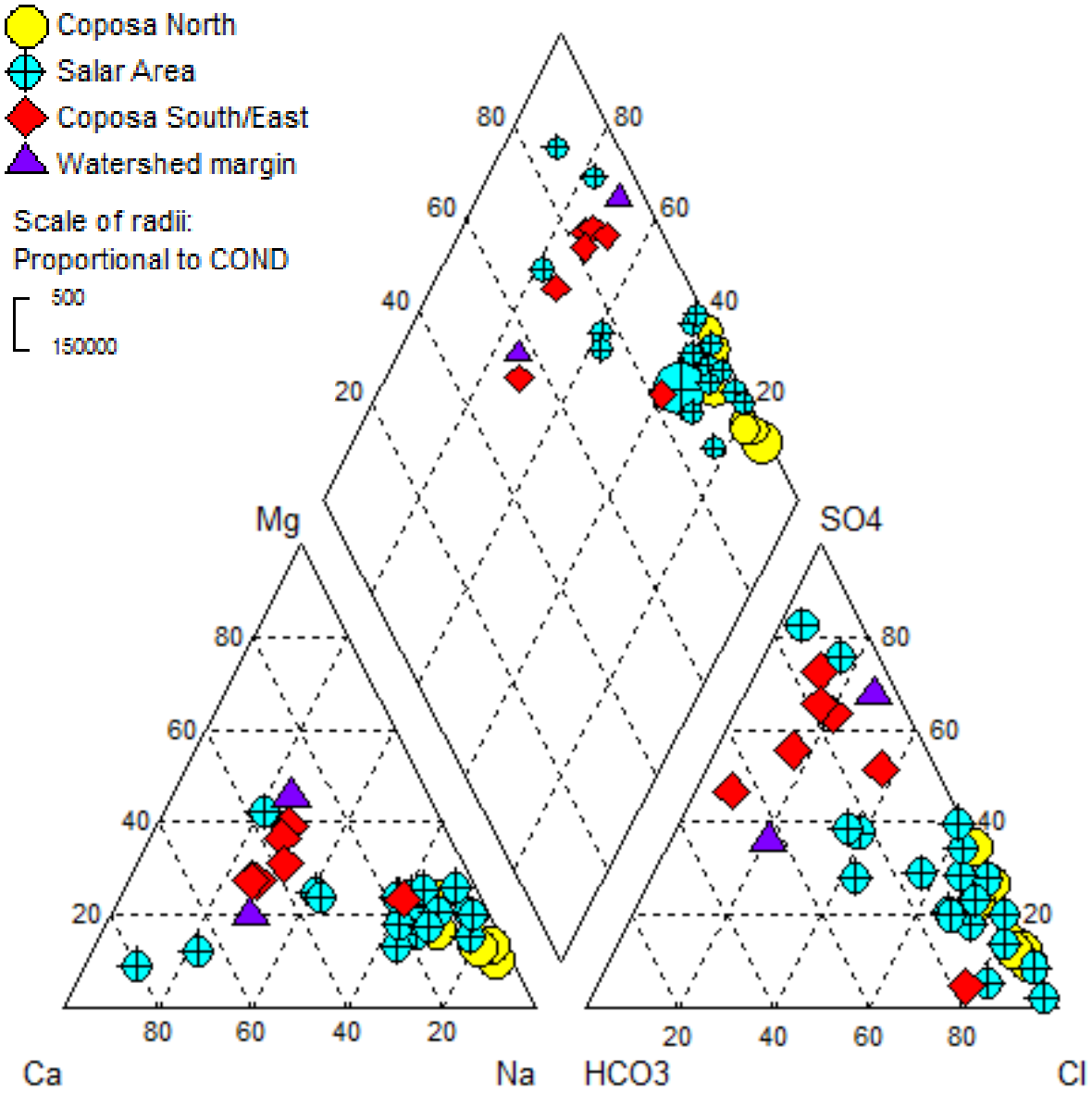
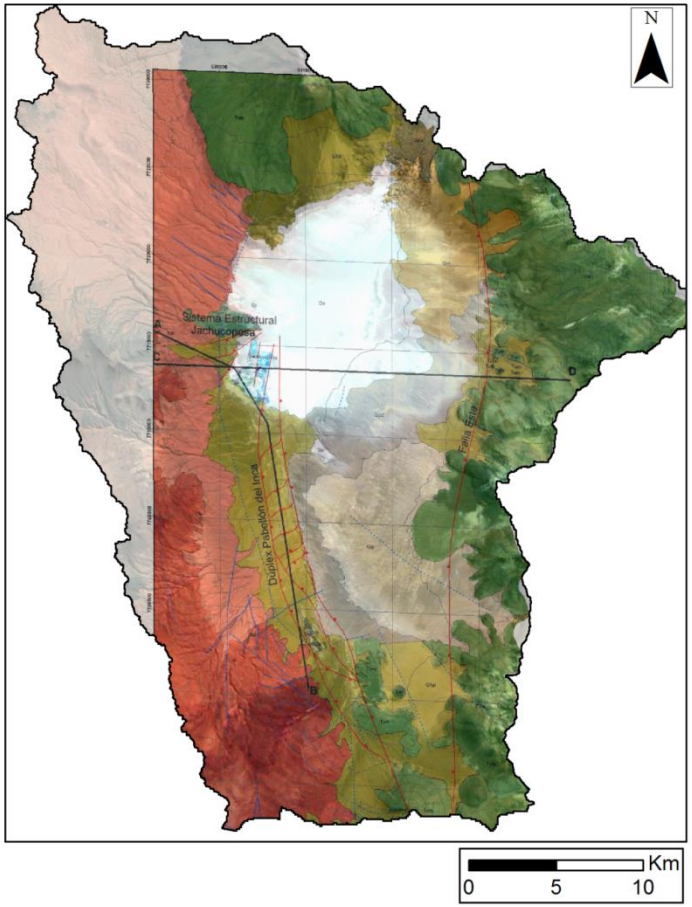
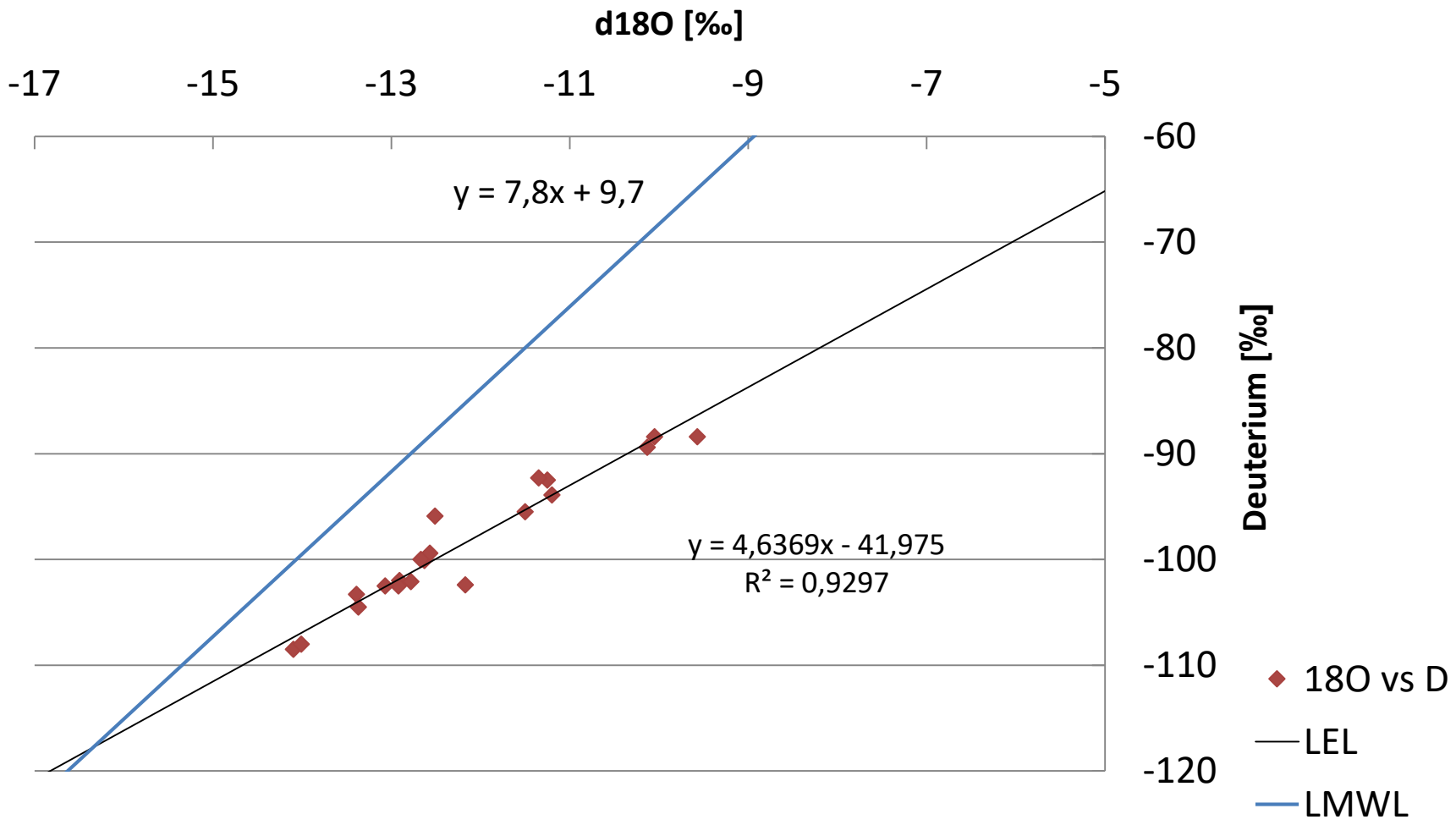
General Groundwater Chemistry

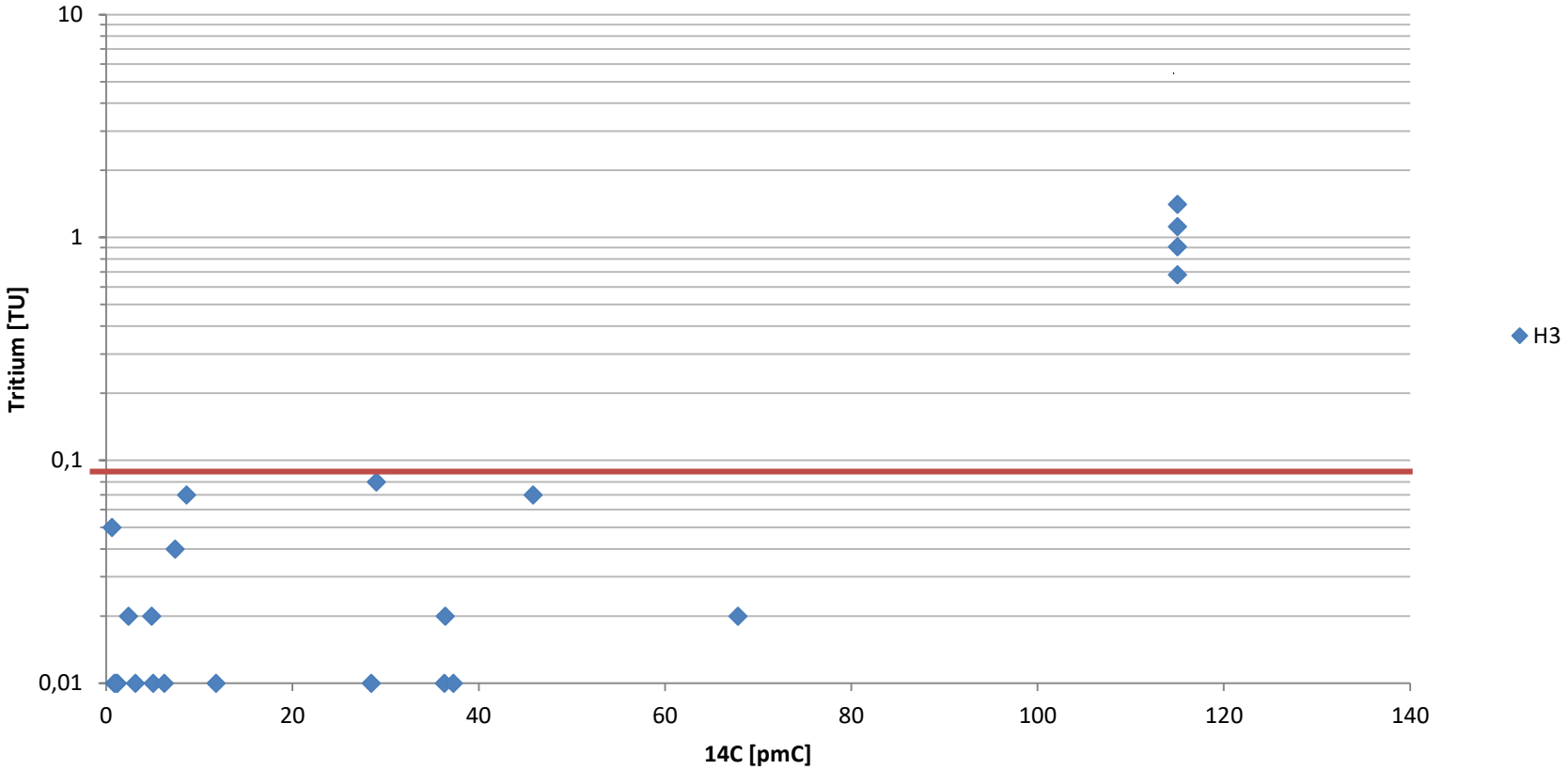




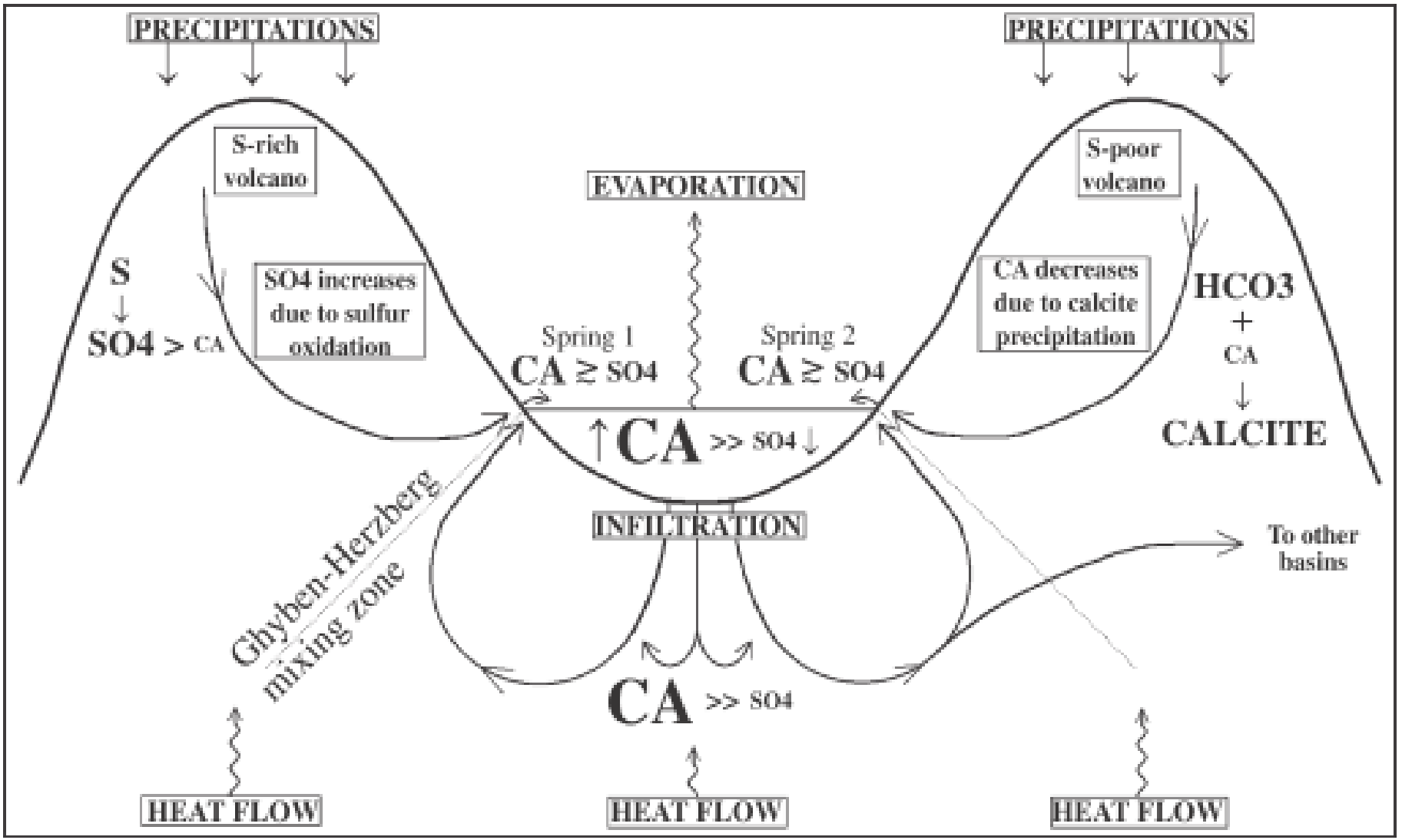
Stable Isotopes



Tritium contents



Schematic groundwater flow



Source: Risacher et al., 2003

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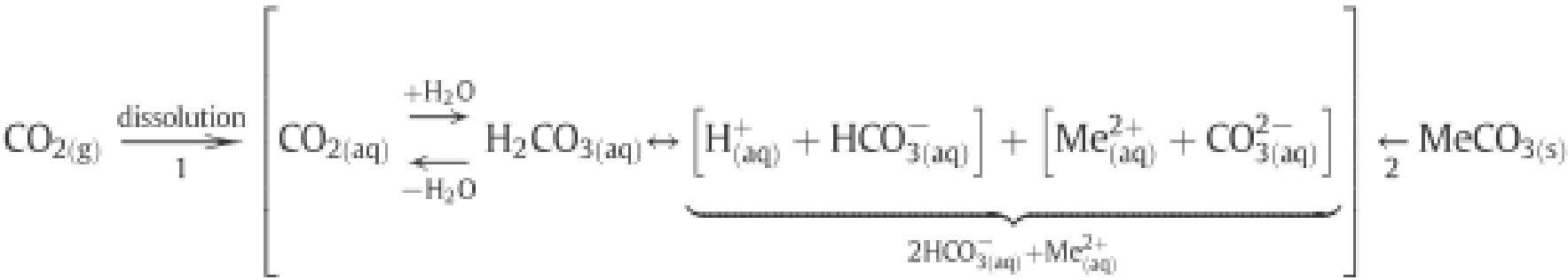
Revised Fontes & Garnier Model
Han & Plummer Model

Correction of

- Carbonate dissolution
- Soil gas CO_2 dissolution
- CO_2 gas–aqueous exchange
- Calcite–HCO_3^- exchange
- Gypsum dissolution
- Ca/Na cation exchange

Carbonate balance



^{13}C distribution in nature