Evolution of crust vs mantle contributions to continental arc granitoids within a few Myr:
Evidence from zircon Hf-O isotopes and high-precision U-Pb dating in the Famatinian Arc, Argentina

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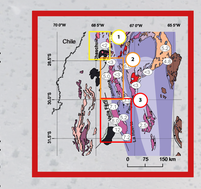
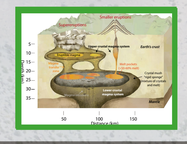
1. Introduction and Rationale

This poster is interactive and needs to be downloaded and read with Acrobat reader to use functionalities.

This study explores the Famatinian magmatic system in North West Argentina. The Famatinian system is divided in 3 main zones representing different crustal levels shifted of about 300km on a N-S axis (**click red icon**). The 3 main zones are thought to be the remnant of a transcrustal magmatic column representing the magmatic refinery capable of transforming basalts into granites via fractionation processes (**click green icon**).

Geochemical investigation, high precision U-Pb dating and isotopes systematics in zircons are used to decipher different aspects of the crust vs mantle contributions in the formation of continental arc granitoïds in the Famatinian arc.





2. Bulk and Zircon Geochemistry

- 62 samples selected for zircon analyses
- Bulk geochemistry (**click on icon**)
  The samples span the entire calc-alkakline differentiation trend of the arc with the most important lithologies from mafic cumulates to volcanic rhyolites. The trends are systematics between the 3 zones.
- Zircon geochemistry (**click on icon**)
  Zircon data also show systematics between the 3 zones. Additionally, we note that lower crustal zircons crystallized at rather low temperature (700 - 800°C).

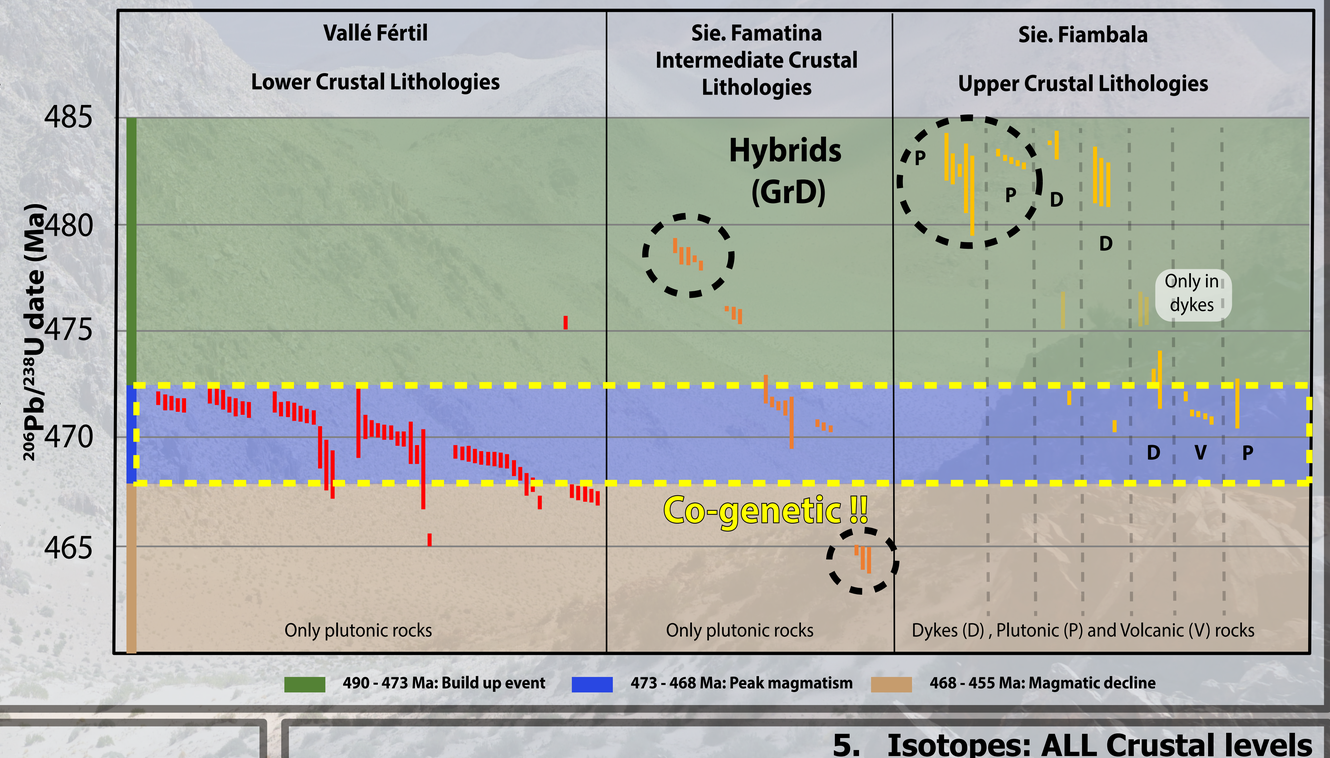
- **Continuous magmatic pile despite longitudinal shift (cf.,1.)**

3. ID-TIMS U/Pb dating Zircons

- Famatinian system = Remnant of the Gondwana active margin (Early Ordovician **490 - 455 Myrs**)
  - **3 main events:** Magmatic build up (**490-473Myrs**), Peak magmatism (**473-468Myrs**) and Magmatic decline (**468-455Myrs**)

- Lower Crustal Lithologies
  Record mainly the Peak magmatism event. Zircon saturation reached only once?
- Intermediate Crustal Lithologies
  Span a ca. 15Myrs succession of intrusions recording the maturation of the mid-crust. Zircon saturation limit crossed often.
- Upper Crustal Lithologies
  Record a "2-pulse" event. "Old" hybrids and "Young" granites, dykes and rhyolites.

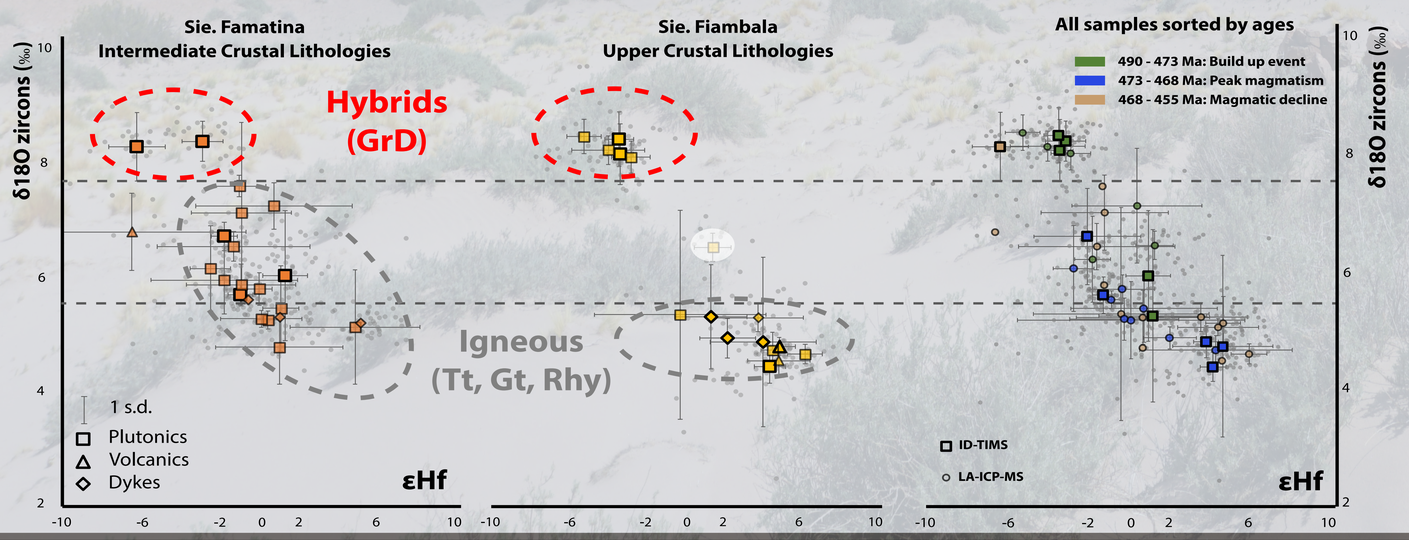
- **Co-genetic transcrustal magmatic column at ca. 470Myrs**



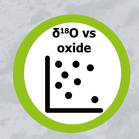
4. $\delta^{18}O$ and εHf Zircon Isotope Geochemistry: Upper and Mid crust

- Systematic co-variation of the O and Hf isotopic signatures of zircon in the mid- to upper crustal rocks from a clearly crustal footprint (granodioritic hybrids with zircon $\delta^{18}O$ of ca. +8 ‰; εHft of ca. –5) to a mantle-like signature (granites and rhyolites: zircon $\delta^{18}O$ of ca. +5 ‰; εHft of ca. +5).
- Upper Crustal Lithologies: "2-pulse" behaviour for $\delta^{18}O$ and εHf. **This is coherent with the ages => 2 main ages**
- Intermediate Crustal Lithologies: Progressive trend from crustal-like to mantle-like signature. **This is also coherent with the ages => 15 Myrs span of ages: more isotopic record.**

- **Hybrids: first magma to rise up in the crust=more crustal interactions / Others: magmatic shielding to eventually preserve mantle signatures**



5. Isotopes: ALL Crustal levels



- $\delta^{18}O$ and εHf all (**click on red icon**)
  εHf missing for the Lower Crustal Lithologies
  Lower Crustal Lithologies have elevated $\delta^{18}O$ values (8-10‰)
- $\delta^{18}O$ vs K_2O all (**click on green icon**)
  2 counter intuitive trends competing with the concept of crustal contamination

- **Lower crustal Lithologies of Vallé Fértil have a contaminated mantle signature - effect of the longitudinal shift?**

6. Discussion

This study focused on 62 samples throughout the Famatinian magmatic column that were prepared for zircon analyses. Geochemical, geochronological and isotopic anlyses led to important conclusions but also arised important questions.

- The geochemical and temporal connections
  Bulk and zircon geochemical data connect the different crustal levels systematically despite the longitudinal shift.
  Temporally, we observed that the different crustal levels have samples of the same age confirming the presence of a **co-genetic magmatic column** during the Peak magmatism event of the Famatinian system.
- The isotopic complexity - lateral variations?
  The isotopes do not show logical continuity between the lower crust and the mid- and upper crust. Local geodynamic events causing lateral slab variations during the Ordovician might be at the origin of such discrepancy (**click on blue icon**).

Crust vs mantle contributions?

The dataset exposed in this interactive poster is quite extraordinary. Indeed, several aspects of crust vs mantle contribution can be adressed. First of all, compiling the ages throughout the different level of the crust reveal that magmatism is co-genetic throughout the magmatic pile confirming the existence of **transcrustal magmatic columns**. Moreover, oldest rock having more crustal like isotopic signatures and youngest ones conserving primitive signatures go towards a **decreasing contribution of the overlying continental crust over time** ("self-shielding" concept). Secondly, the longitudinal shift provides a remarkable opportunity to investigate lateral paleo variation in the nature and composition of primary basalts from the mantle wedge. We attribute the shift in isotopic behaviour from lower to upper crustal lithologies to a different isotopic reservoir directly linked to the variation of subducted materials along the paleo-arc axis. Therefore, the **mantle contributions to continental granitoïds remains majoritarily dominant** when the magmatic system is mature (Peak magmatism).