Potassic and ultrapotassic rocks from the Roman Magmatic Province: crustal and mantle processes involved in terrains' Au (in)fertility

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Introduction

- Potassic arc igneous rocks are often associated with gold deposits
- There is a general consensus that a thoroughly metasomatized SCLM is required for gold ore genesis
- *The Roman Magmatic Province features both potassic volcanism and a metasomatized SCLM*

So…why no gold mineralization has ever been found in this area?

The Roman Magmatic Province (RMP)

This study considers the Vulsini (VVD), Sabatini (SVD) and Alban Hills (AHVD) volcanic districts, characterized by (Peccerillo, 2005):

- Large volcanic centres with water-filled calderas
- Magmatic activity: 0.6 - 0.1 Ma
- Dominant pyroclastic and phreatomagmatic activity; subordinated lava flows
- Mainly SiO_2-undersaturated tephrites, phonotephrites and foidites
- 3 km-thick carbonate basement.

In this study we considered 13 lava samples and an ultramafic xenolith from the AHVD. Data were collected during an international collaborative effort involving the Universities of Bologna, Milano – La statale, the Queensland University of Technology and the University of Western Australia.

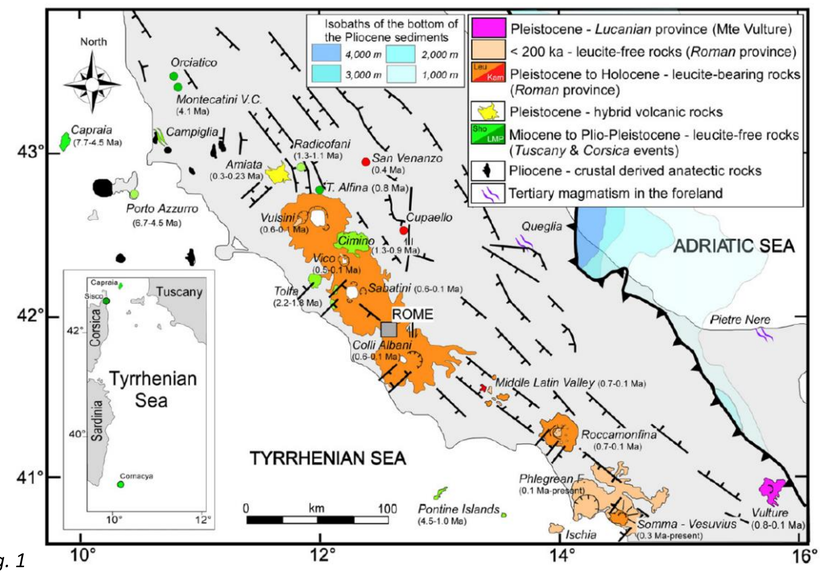


Fig. 1
Conticelli et al., 2015

Results

Most of the rock samples are SiO_2-undersaturated ultrapotassic rocks. They are mainly tephrites, phonotephrites and foidites.

Multi-element diagram:

- Ba, Nb, Ta, Ti and P negative anomalies
- Th, U, K and Pb positive anomalies
- High LILE/HFSE ratio
- U/Nb and K/Nb >> 1

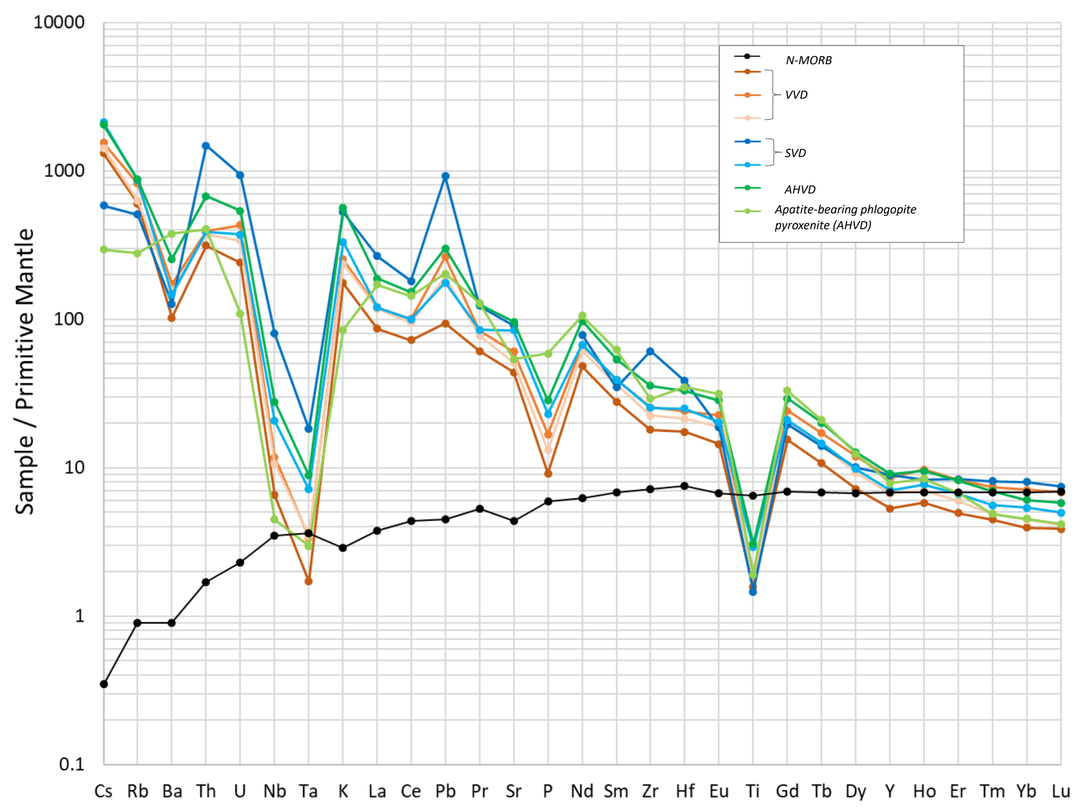
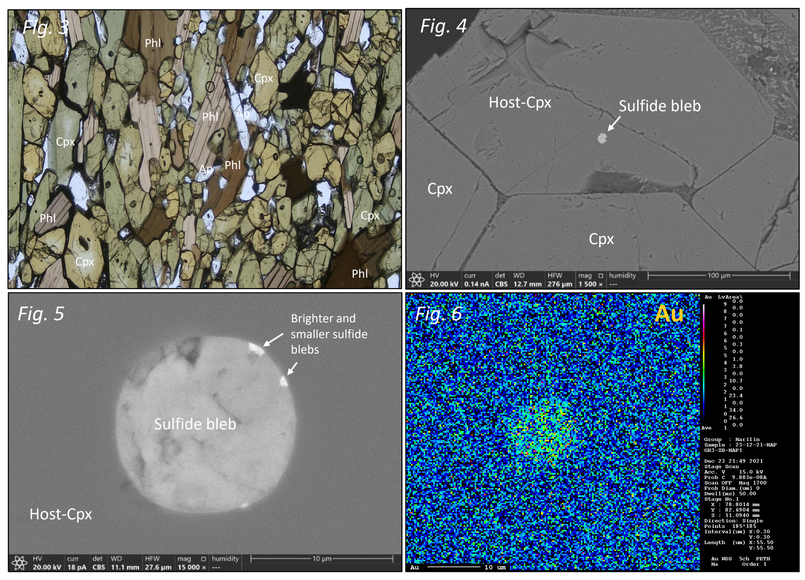


Fig. 2

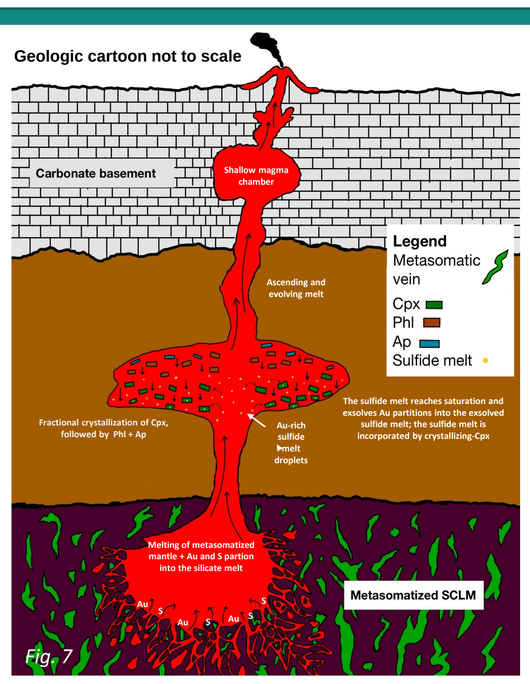


The ultramafic xenolith is an apatite-bearing phlogopite clinopyroxenite.
6 sulfide blebs were recognized inside the xenolith.

- Consistenly clinopyroxene-hosted
- Rounded to slightly irregular in shape
- Au-enriched blebs

Discussion

- Trace elements suggests a magma genesis in a metasomatized mantle domain enriched by relatively Ba- and Sr-poor fluids
- Sulfide blebs entrapped during cpx crystallization and growth; magma. Such an exsolution would significantly deplete gold in the latter and enrich the former, due to high S affinity of Au (Li & Audétat , 2013).
- Prolonged fractional crystallization acted as a filter probably at mid-to-deep crustal levels, progressively scavenging Au (and other highly siderophile elements) from each new magma batch
- The residual liquid eventually moved towards the surface emplacing the voluminous Roman lavas and pyroclastics.



Conclusion

- RMP melts were primarly enriched in gold but they reached sulfide saturation at depth and lost their metal budget.
- The lack of any kind of Au-mineralization in the Roman Magmatic Province is likely primarly due to the acquired gold-scarcity of its melts.
- It is here suggested that sulfide melt exsolution is a first-order process to determine gold-infertility in K-rich alkaline igneous provinces.

WAY FORWARD Geothermobarometry is required to support our scenario and constrain P-T conditions of clinopyroxenite formation.

Reference

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Peccerillo, A., 2005. Plio-Quaternary Volcanism in Italy: Petrology, Geochemistry, Geodynamics. Springer, Berlin Heidelberg New York.
Li Y. & Audétat A., 2013. Gold solubility and partitioning between sulfide liquid, monosulfide solid solution and hydrous mantle melts: Implictaions for the formation of Au-rich magmas and crust-mantle differentiation. Geochimica et Cosmochimica Acta, 118: 247-262.