Hydrothermal Alteration and Multiple Sulfur Isotope Chemistry of Kayad Zn-Pb Deposit, Ajmer, Rajasthan, Western India: Implications for Ore Genesis

Eileena Das

Department of Geological Sciences

Jadavpur University, Kolkata, India

eileenadas1995@gmail.com
eileenad.geology.rs@jadavpuruniversity.in

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GEOLOGY

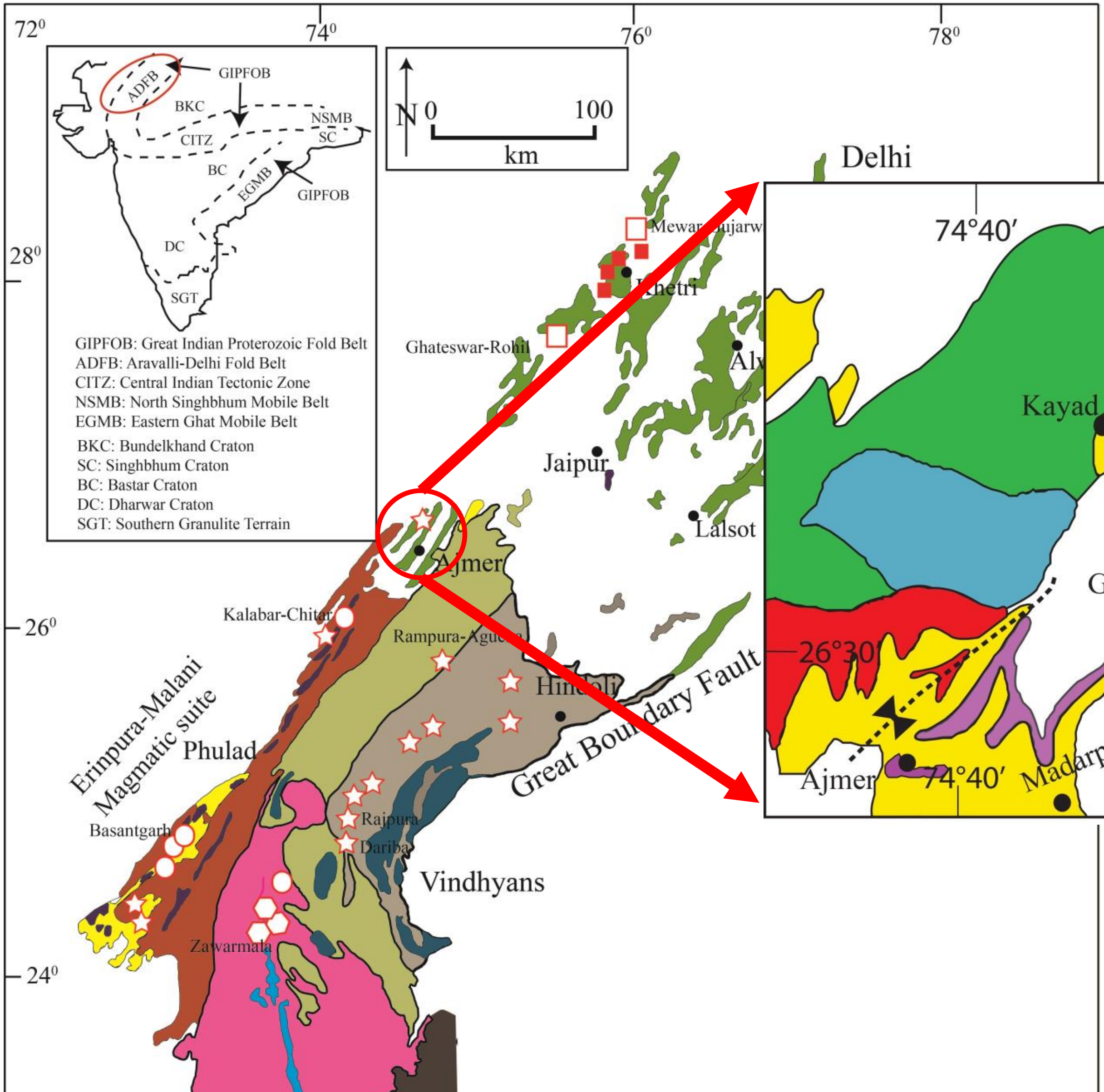


Fig. 1: Geological map of Delhi Aravalli Fold belt with the lithological units and locations of different deposit types (modified after Deb et al., 2001)

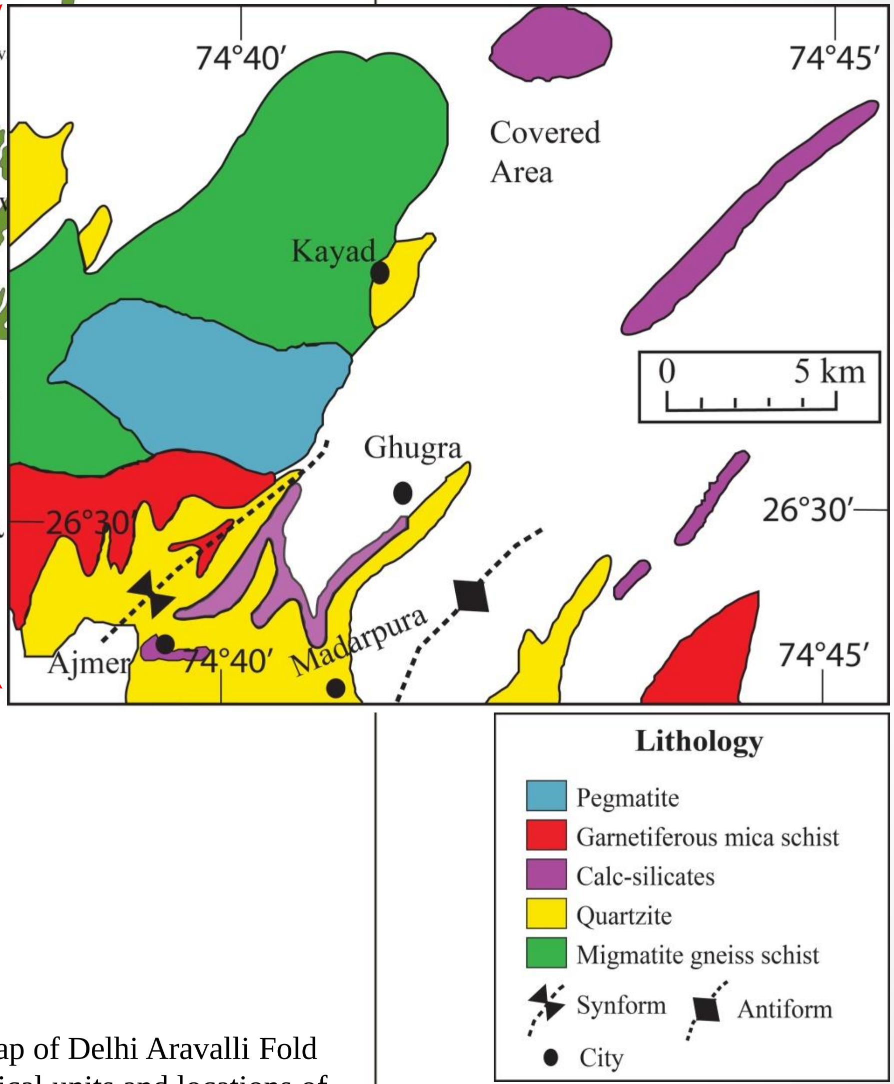


Fig. 2: Geological map of Kayad (redrawn from Sarkar and Deb, 2012)

SULFIDE ORE HOSTS

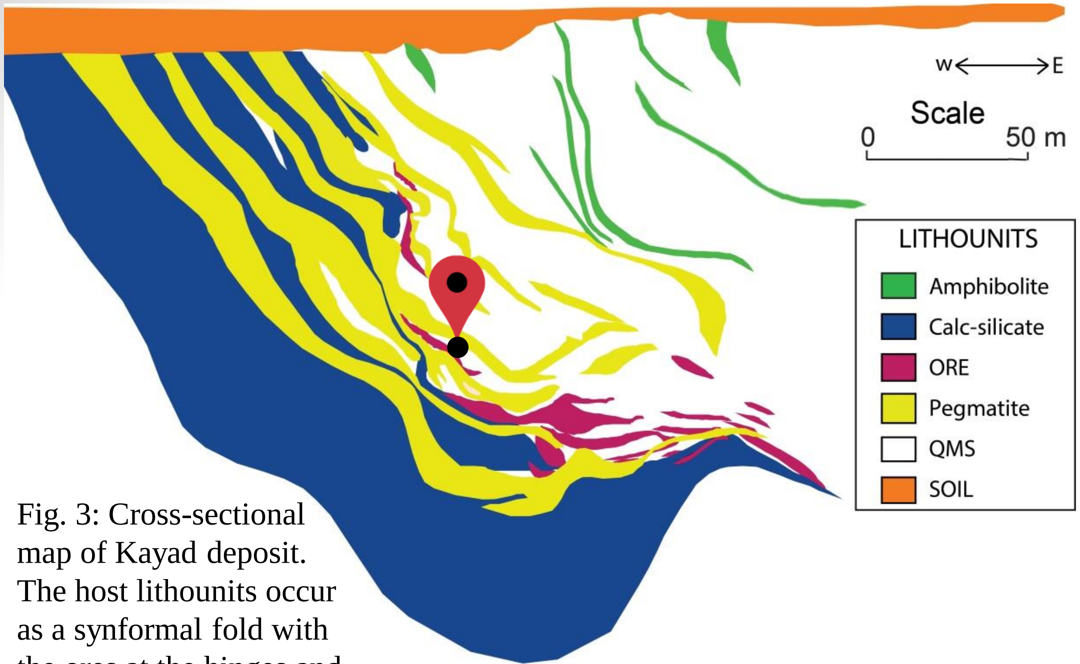
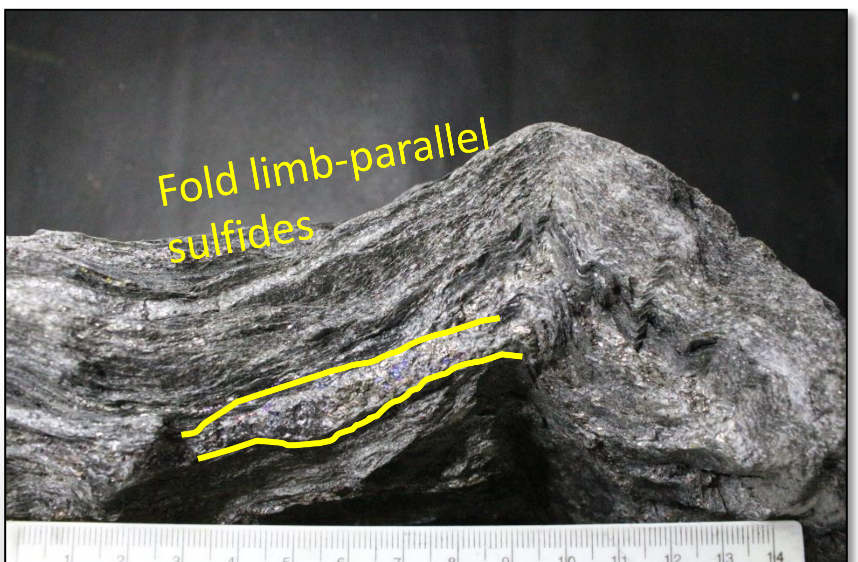


Fig. 3: Cross-sectional map of Kayad deposit. The host lithounits occur as a synformal fold with the ores at the hinges and eastern limb.

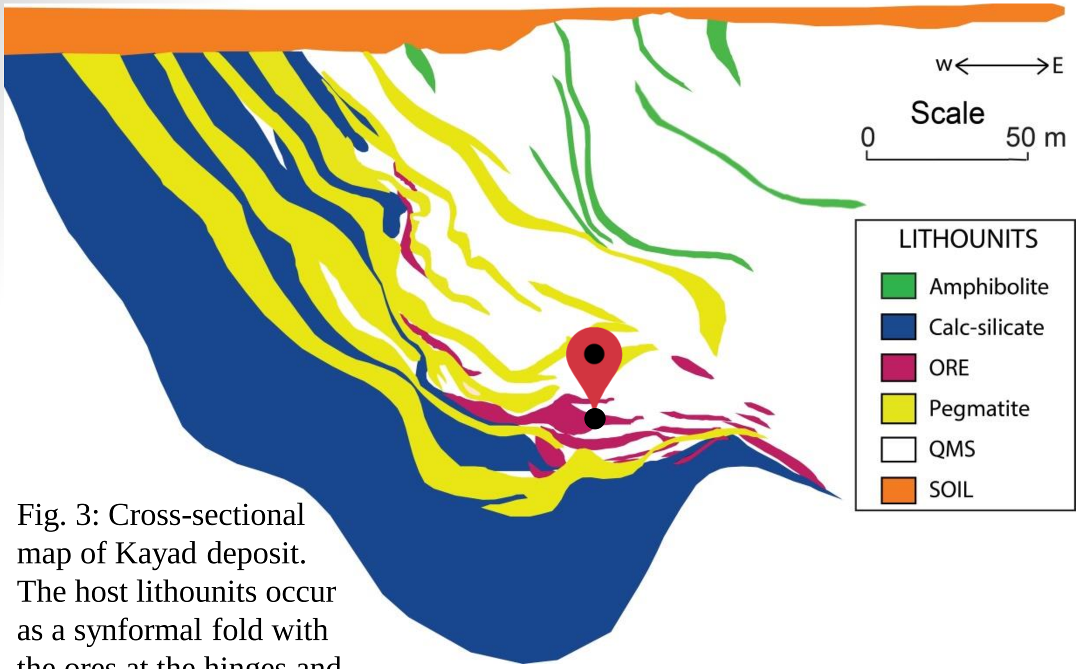
Host Rocks:

- QMS Laminated
- QMS Massive
- Calcsilicate
- Quartzite
- Quartzo-feldspathic/quartz veins



QMS Laminated : Sphalerite + Pyrrhotite ± Chalcopyrite

SULFIDE ORE HOSTS



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Host Rocks:

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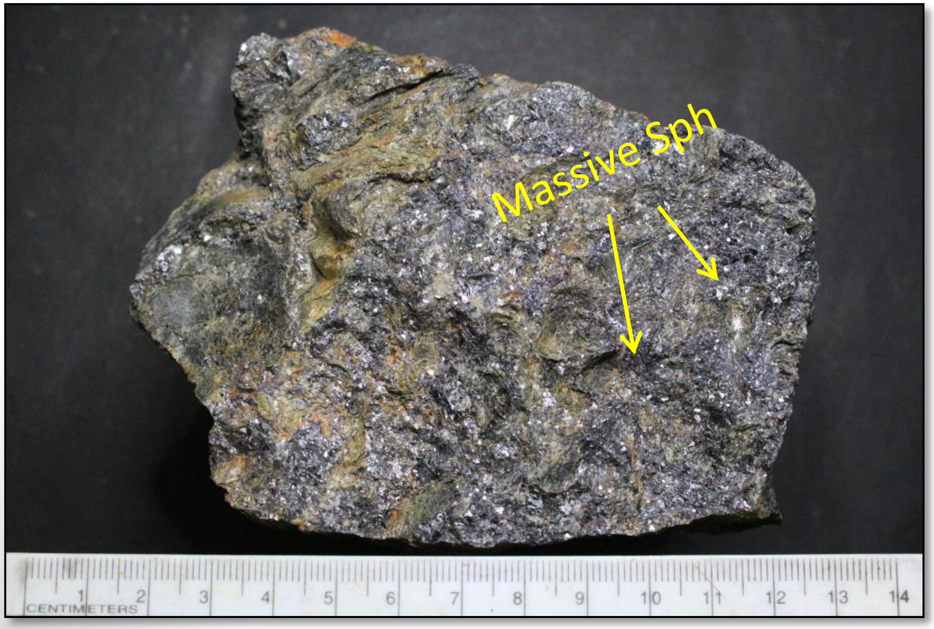
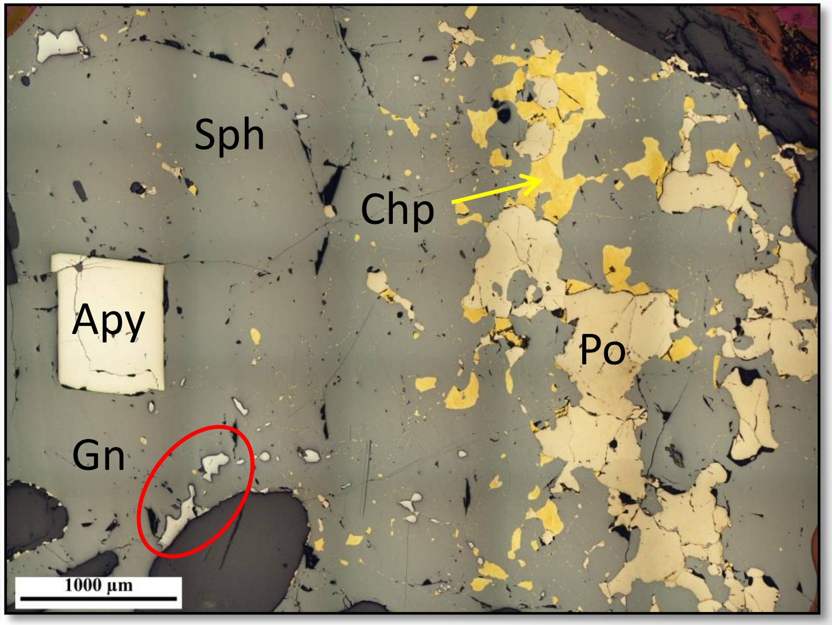
QMS Massive : Sphalerite + Galena + Pyrrhotite + Chalcopyrite + Arsenopyrite

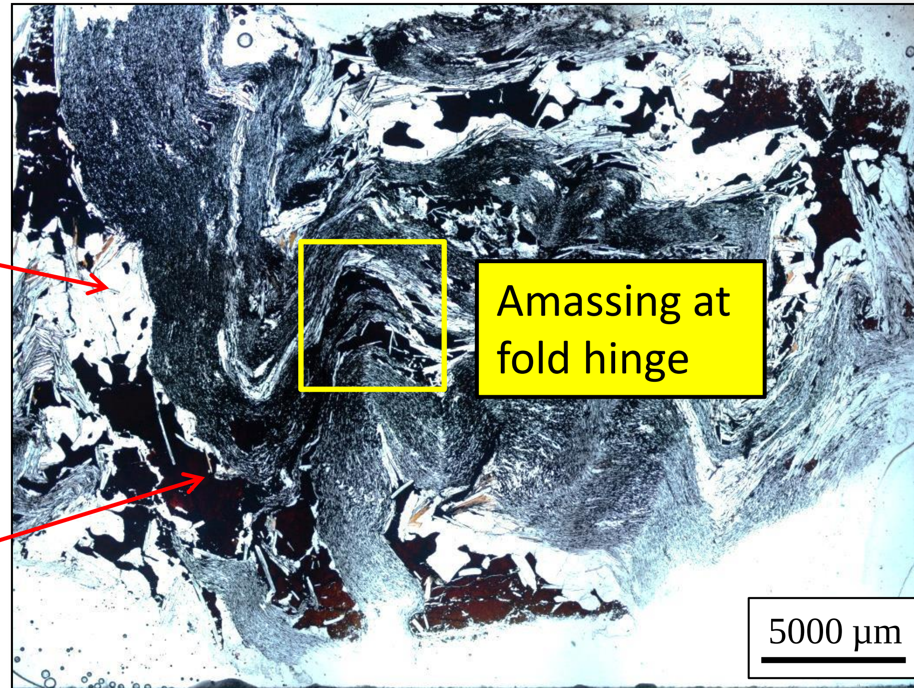


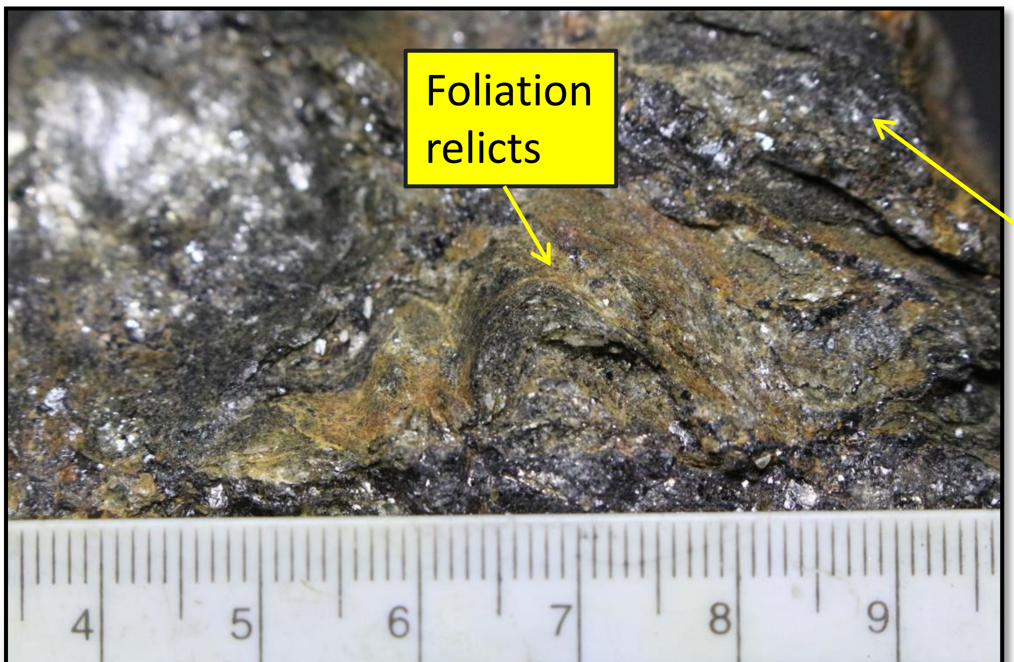


MASSIVE SULFIDES

Coarse quartz grains with massive sulfide

Sphalerite +Galena





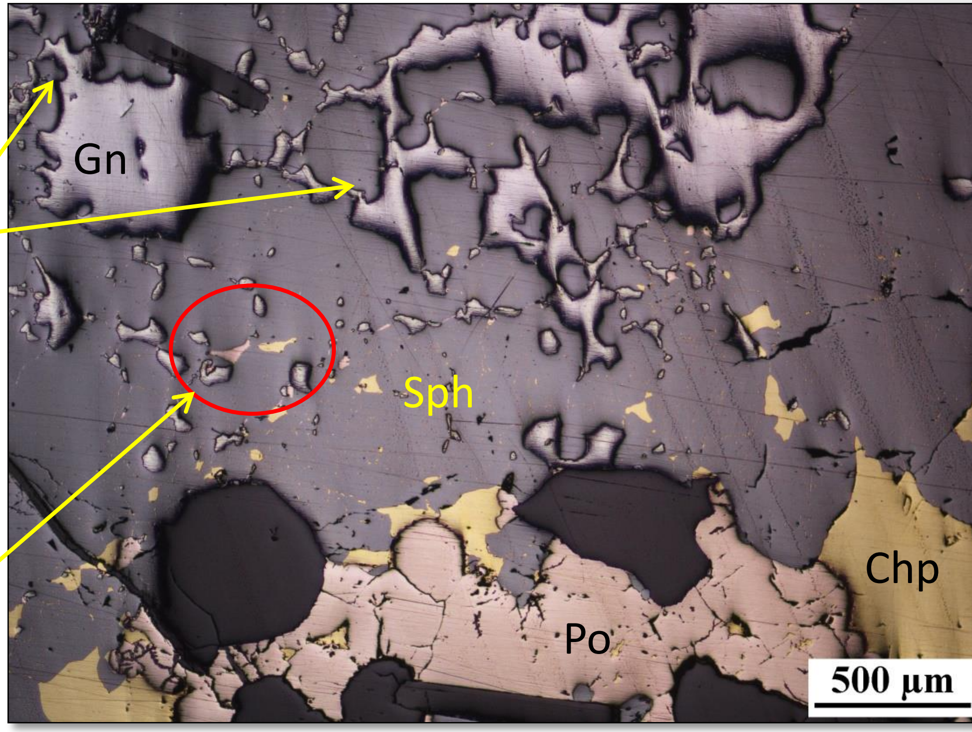
Massive sphalerite

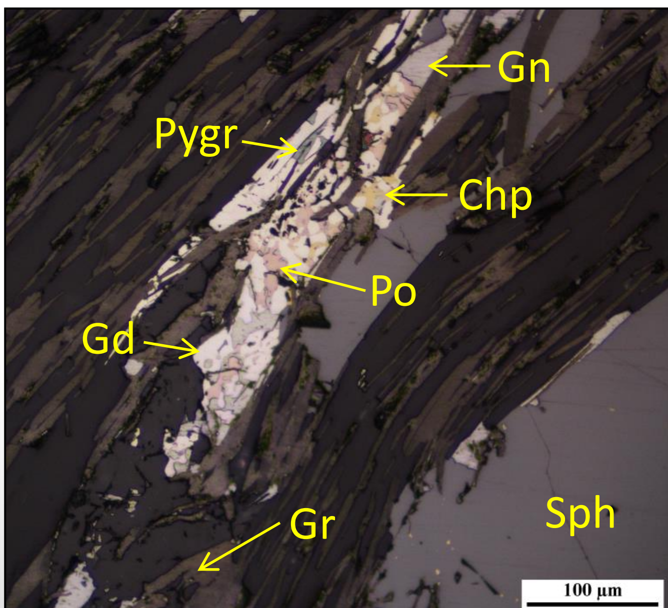
Durchbewegung texture

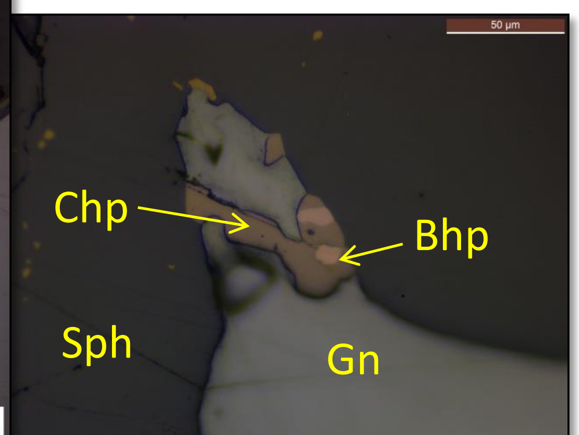
MASSIVE SULFIDES

Galena cusps with low dihedral angles

Blebs of galena and chalcopyrite in sphalerite matrix

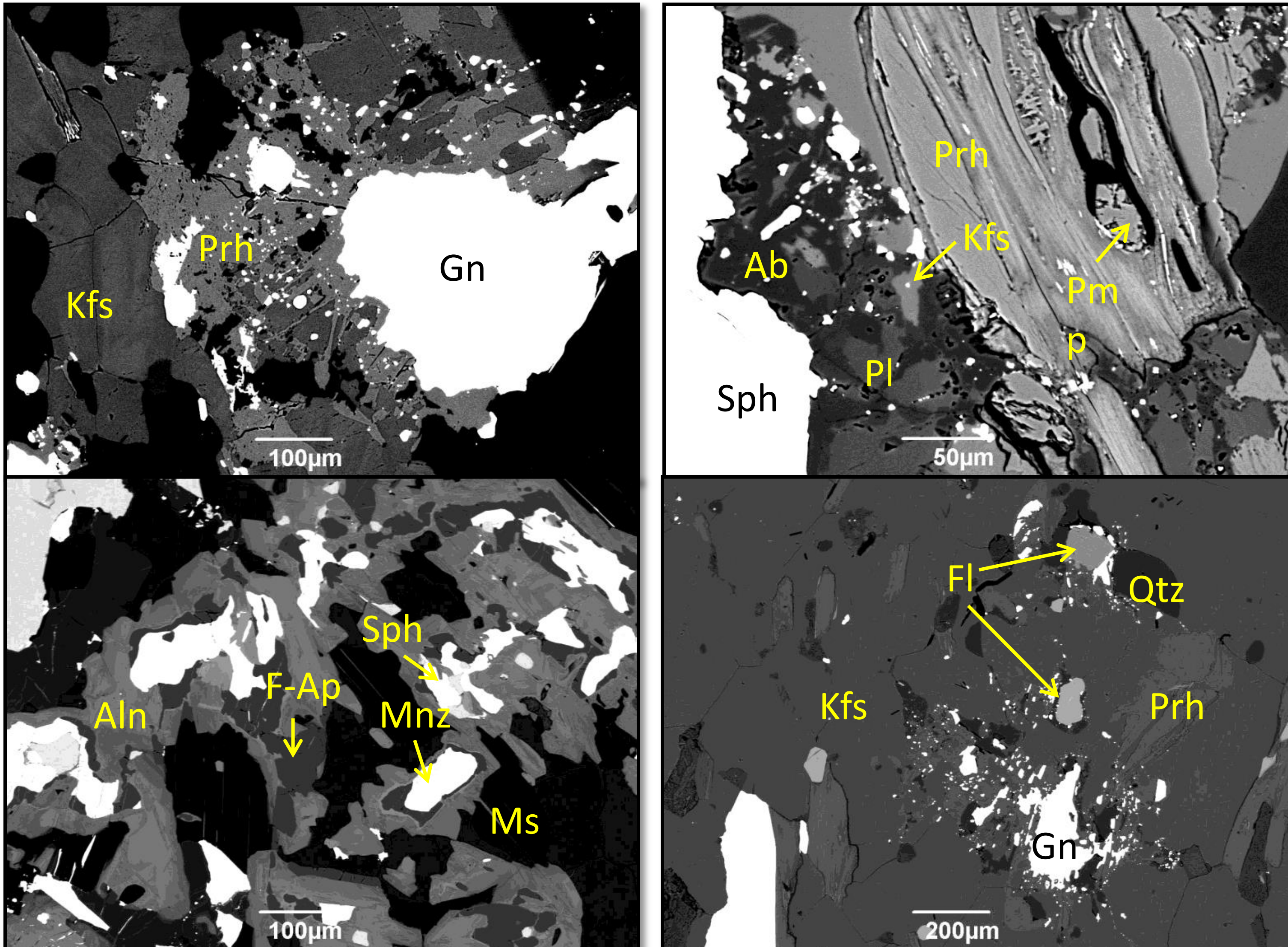






Presence of sulfosalts like pyrargyrite (Pygr), gudmundite (Gd) and breithauptite (Bhp) with massive ores indicate role of LMCEs

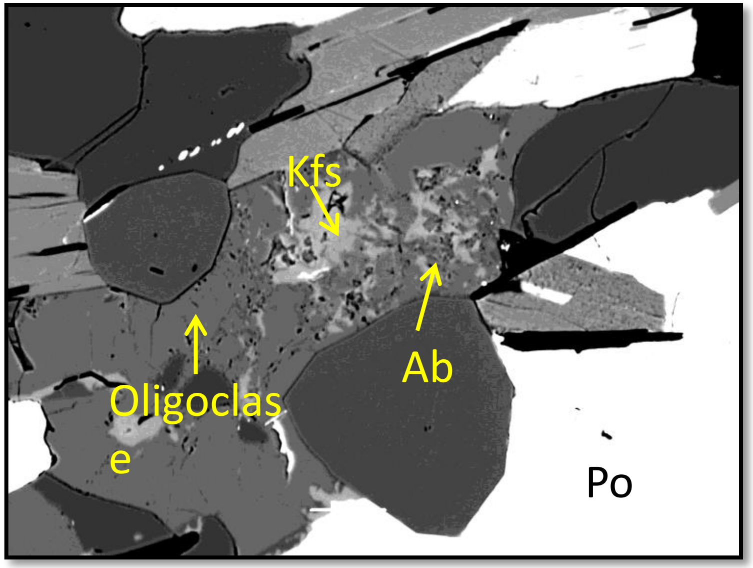
Alteration assemblage 1: Prehnite, pumpellyite (Al), albite, clinochlore and Ce-rich allanite, monazite, fluoroapatite ± fluorite ± clinozoisite

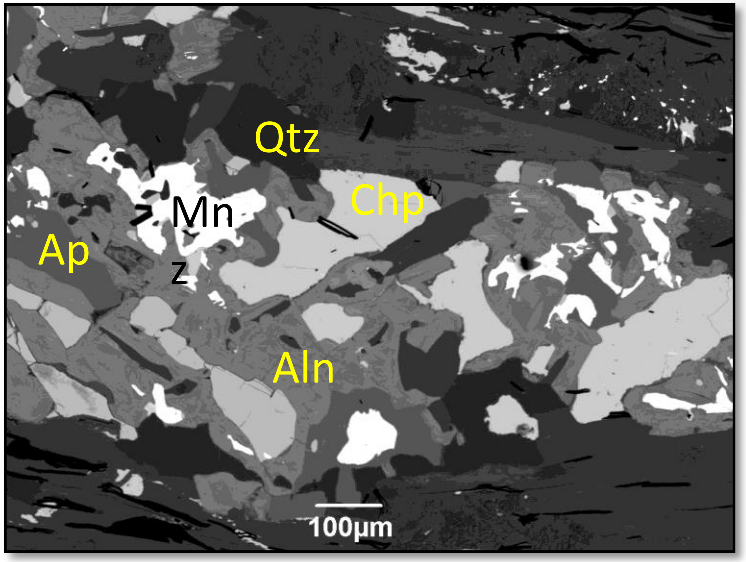


Implies a **Ca+Na+Fe +P+F** alteration with associated REE metasomatism!

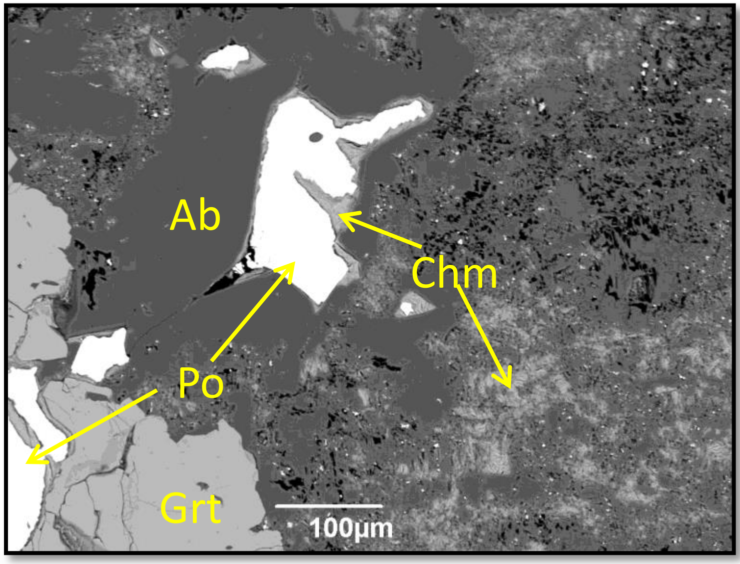
HOW ARE THEY ALTERED?

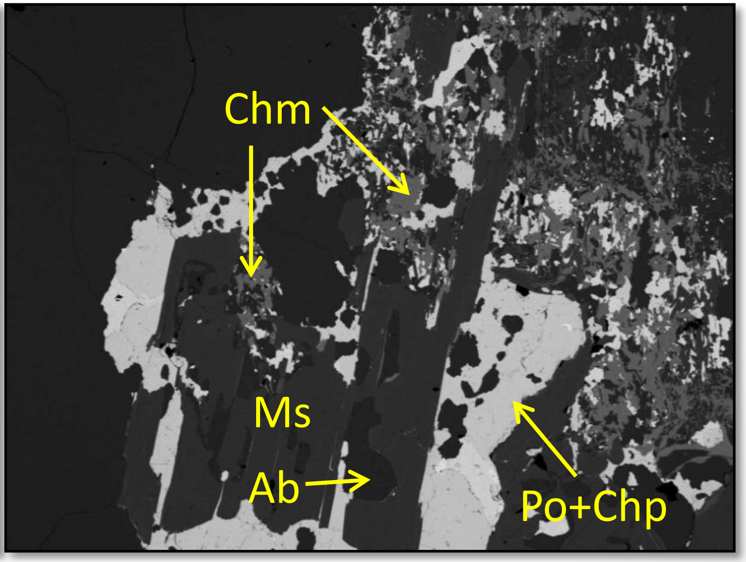
Alteration assemblage 2: Orthoclase, albite and Ce-rich allanite, monazite, fluoroapatite





Implies a **K+Na+P+F** alteration with associated REE metasomatism!





HOW ARE THEY ALTERED?

REMOBILIZED YOU SAY?

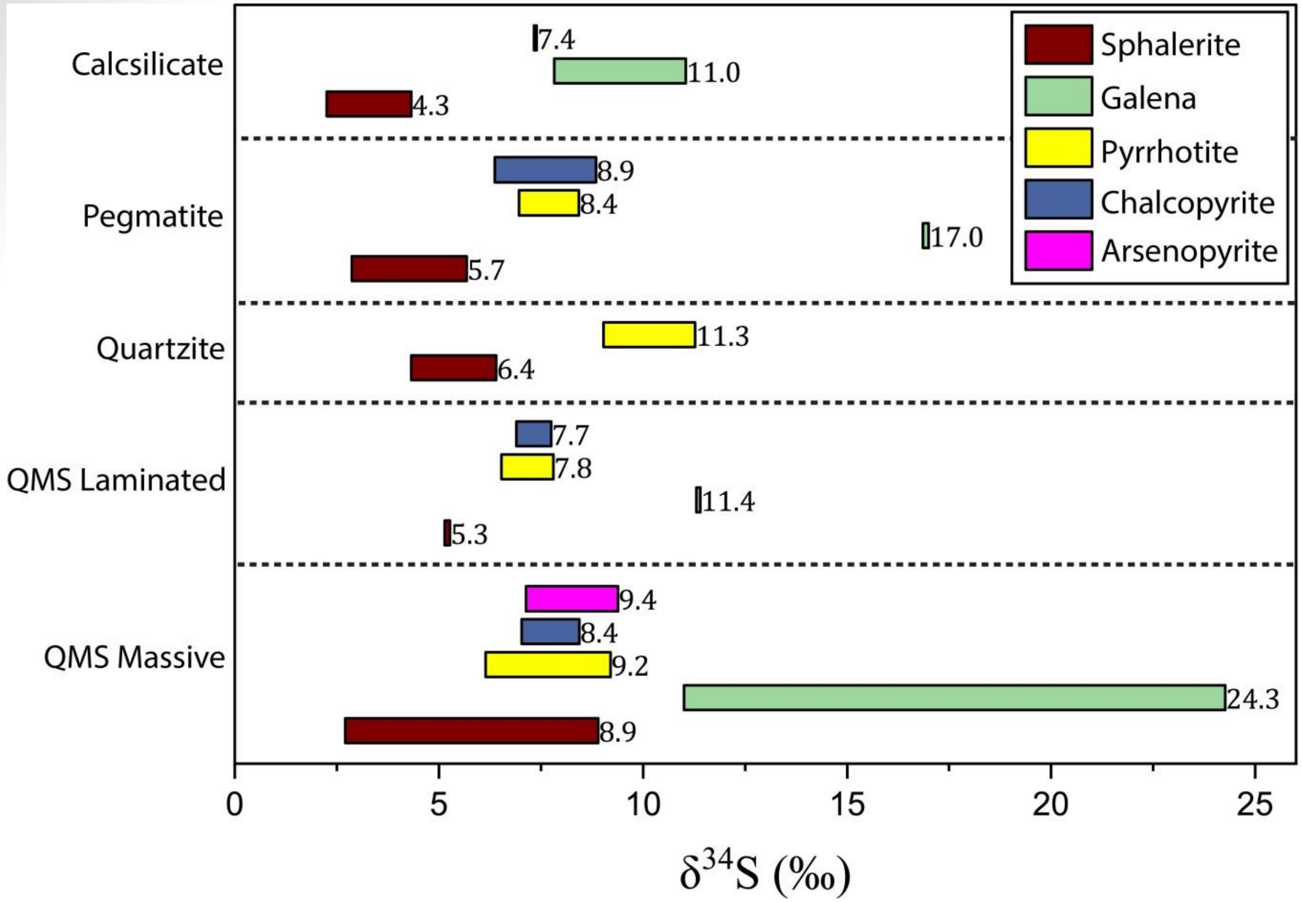


Fig. 4: Sulfur isotope variations in sphalerite, galena, pyrrhotite, chalcopyrite and arsenopyrite

- ✓ Positive values of $\delta^{34}S_{VCDT}$ of all five sulfides in all host rocks indicate thermochemical reduction of a heavy sulfate source.
- ✓ $\Delta^{33}S_{pyrrhotite}$ and $\Delta^{33}S_{chalcopyrite}$ average at -0.01 and 0.1 but are within error margins, indicating MDF of sulfur.

Conclusion

1. The ore bodies at Kayad Zn-Pb deposits have formed by syn-deformational remobilization of primary sedex mineralisation.
2. Remobilization has occurred via formation of sulfide melts at amphibolite grade temperatures owing to the low melting chalcophile elements like As, Sb, Ag and Bi.
3. Presence of secondary hydrothermal minerals associated with the massive ores suggest role of hydrothermal fluids, in addition to melt, in the mobilization of sulfides.
4. Comparable $\delta^{34}S_{VCDT}$ isotope values of laminated ores and massive ores indicate recycling of primary sedex sulfur during massive ore formation.
5. Consistently positive $\delta^{34}S$ values hint at a heavy, possibly seawater sulfate that has been thermochemically reduced, as the source of sulfur for the primary sedex ores.

THEREFORE…

References

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Pruseth, K. L., Mishra, B., Jehan, N., & Kumar, B. (2016). Evidence of sulfide melting and melt fractionation during amphibolite facies metamorphism of the Rajpura–Dariba polymetallic sulfide ores. *Ore Geology Reviews*, *72*, 1213-1223.
Deb, M., Thorpe, R. I., Krstic, D., Corfu, F., & Davis, D. W. (2001). Zircon U–Pb and galena Pb isotope evidence for an approximate 1.0 Ga terrane constituting the western margin of the Aravalli–Delhi orogenic belt, northwestern India. *Precambrian Research*, *108*(3-4), 195-213.
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ABOUT ME

FLUID

INCLUSION

LABORATORY

Undergraduate: B.Sc. In Geological Sciences

Postgraduate: M.Sc. In Applied Geology

Master's Thesis: Major and trace element variations in oxide and sulfide minerals of the archean komatiites within the Gorumahishani greenstone belt, Singhbhum craton (Eastern India).

Pursuing Ph.D. in: Ore Geology/Geochemistry

Topic: Origin and geochemical evolution of the Kayad Zn-Pb deposit, Rajasthan, India: Constraints from mineralogy, geochemistry and fluid inclusion studies.

My Supervisor: Prof. Dipak C. Pal