Orthogonal Tectonic and Magmatic Fabrics in a Layered Granite-Gneiss at Remal Dam Site, India: Implications for Fabric Generation and Superposition

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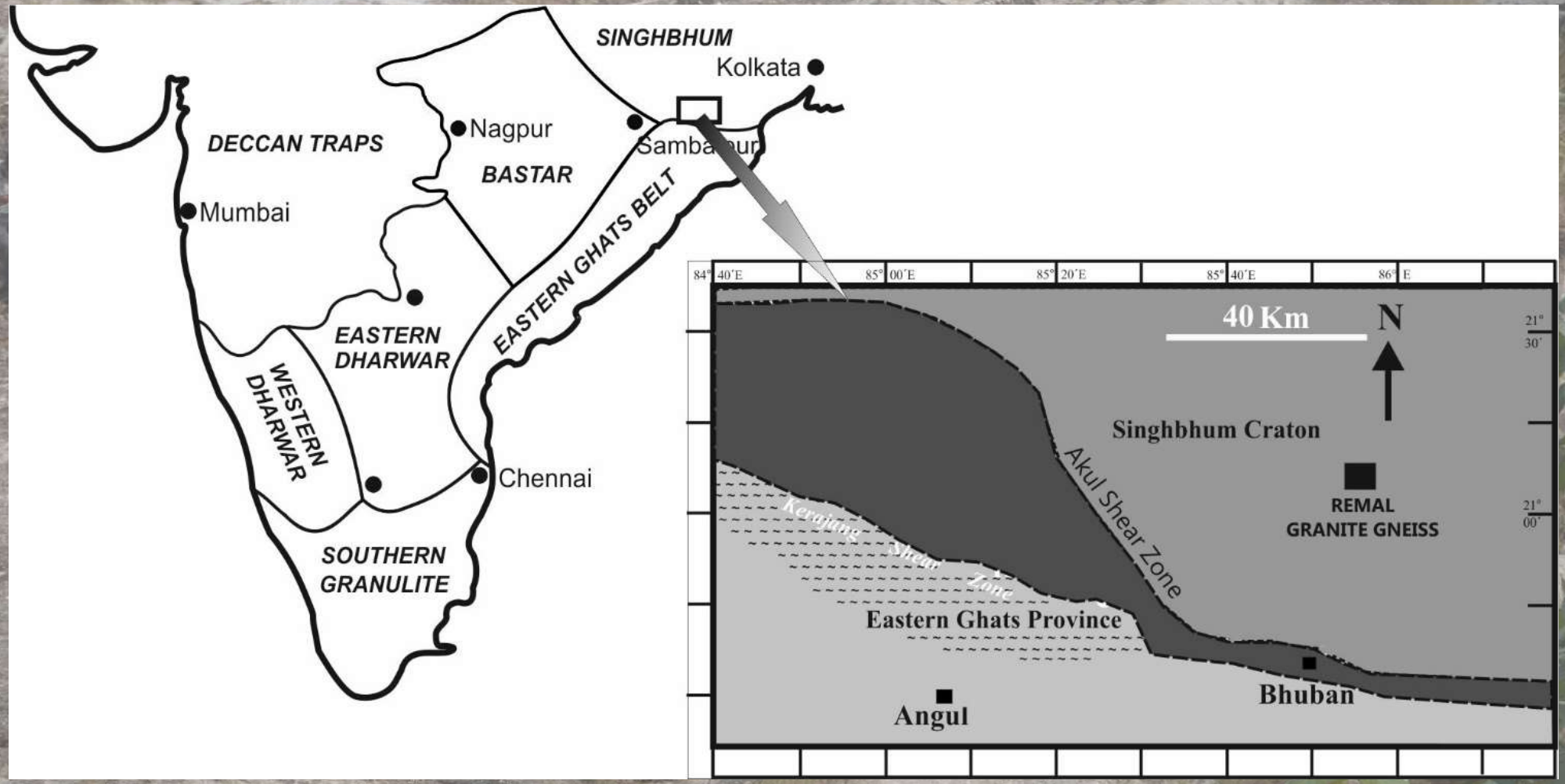
INTRODUCTION



The Remal granite-gneiss is situated in the state of Odisha, India and is part of its Archaean Cratonic nucleus

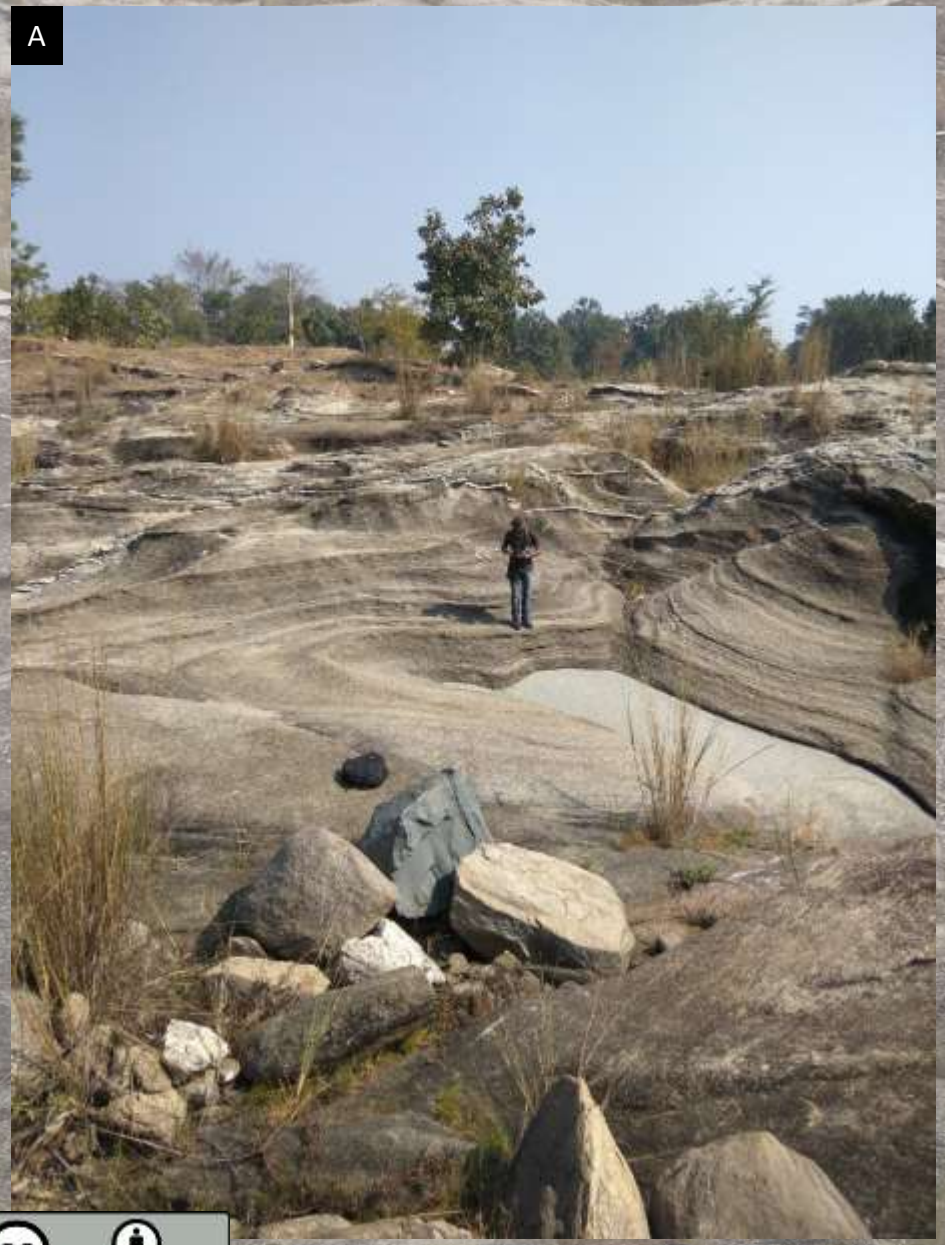
INTRODUCTION

The Remal granite-gneiss is intriguing from a petrological and structural perspective for a number of reasons:

- **It preserves an early formed magmatic layering of felsic composition which is overprinted by a later metamorphic fabric which resembles a gneissosity**
- **The gneissic fabric is sub-parallel to localized mylonite zones which contain abundant chlorite and epidote, indicative of low metamorphic temperatures**
- **Can gneissic layering therefore develop at low strain and low metamorphic temperatures?**

FIELD OBSERVATIONS

A

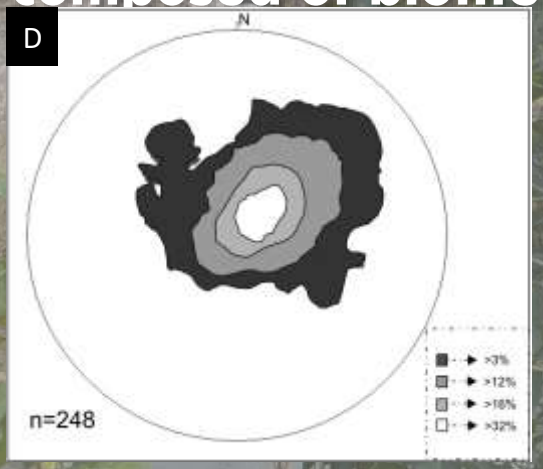


B

C

- The igneous layering (S_{ign}) is felsic in composition
- The layers have a curvilinear geometry, truncate against layers above and below and resemble cross-beds in sediments
- The metamorphic foliation (S_1) is composed of biotite

D



FIELD OBSERVATIONS

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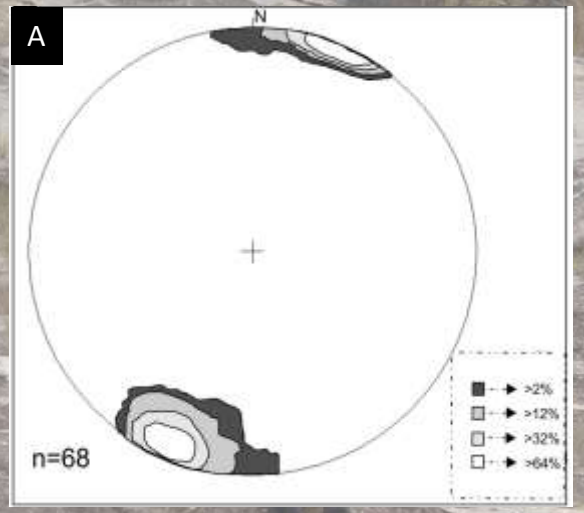
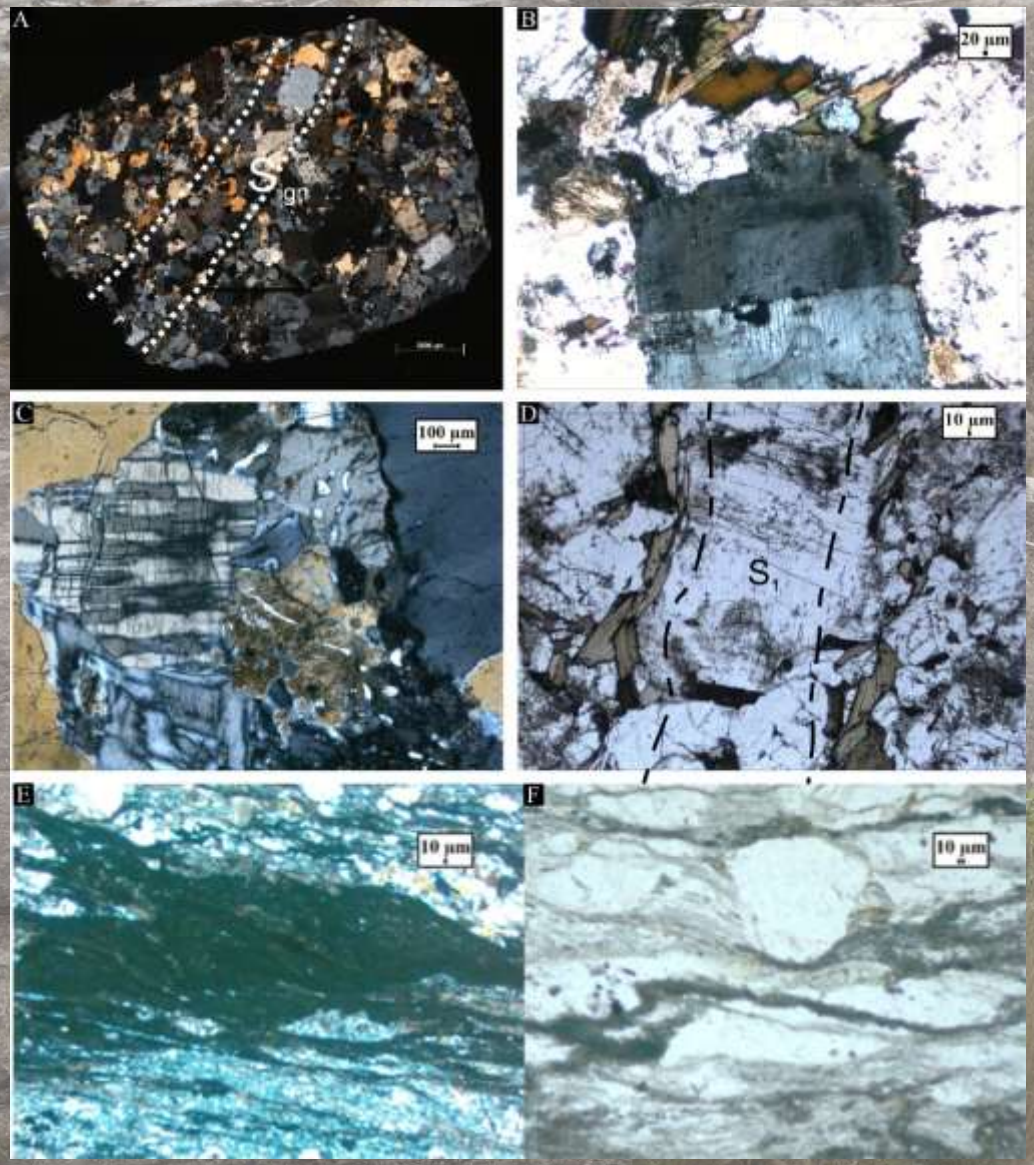


- The gneissosity defined by biotite shows a remarkably consistent orientation
- It is sub-parallel to a greenschist facies mylonite

B

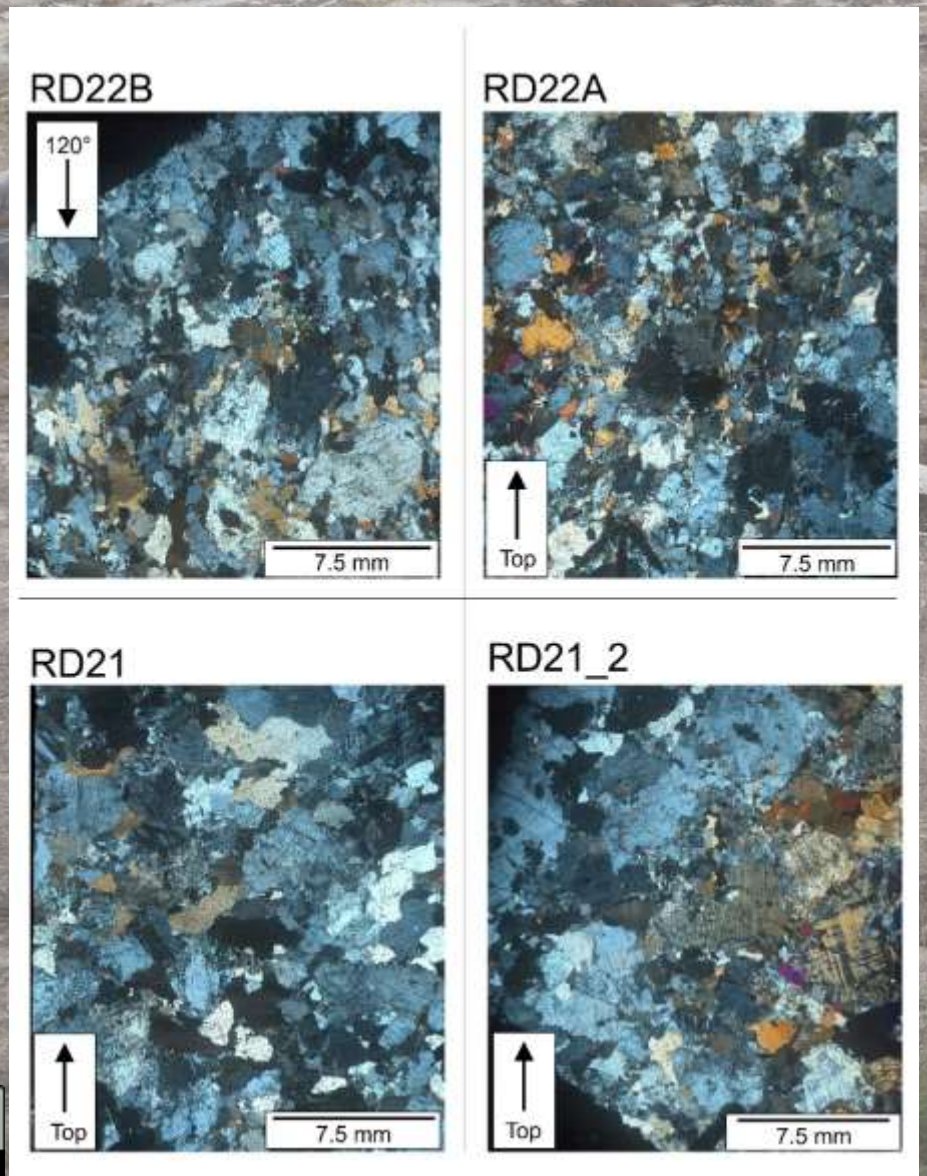
C

THIN SECTION PETROGRAPHY



- Segregations of quartz, K-feldspar and plagioclase with varying grain sizes constitute the S_{ign} layers
- The persistence of zoned grains of plagioclase, graphic intergrowths and lack of metamorphic equilibration are testament to the igneous character of the rock
- The (S_1) layers are defined by crudely aligned grains of biotite
- The mylonite shows prominent dextral asymmetry along C type shear fabrics with intervening rotated porphyroblasts of quartz

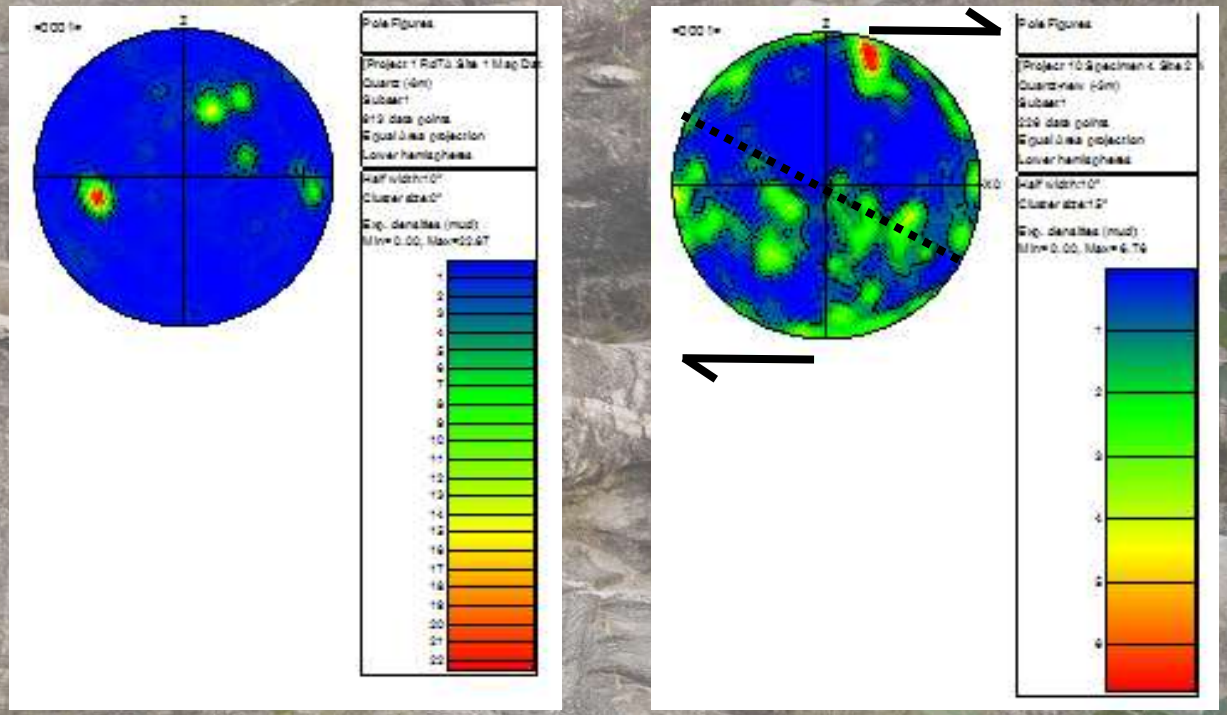
THIN SECTION PETROGRAPHY



- Segregations of quartz, K-feldspar and plagioclase with varying grain sizes constitute the S_{ign} layers
- Horizontal sections close to the biotite fabric contain stretched ribbons of quartz parallel to the S_1 layering
- S_{ign} layers are most prominent in vertical sections away from the S_1 layers

EBSD STUDIES

Quartz CPOs have been analyzed in samples away from the mylonite and in the vicinity of it to understand the mechanisms of strain localization



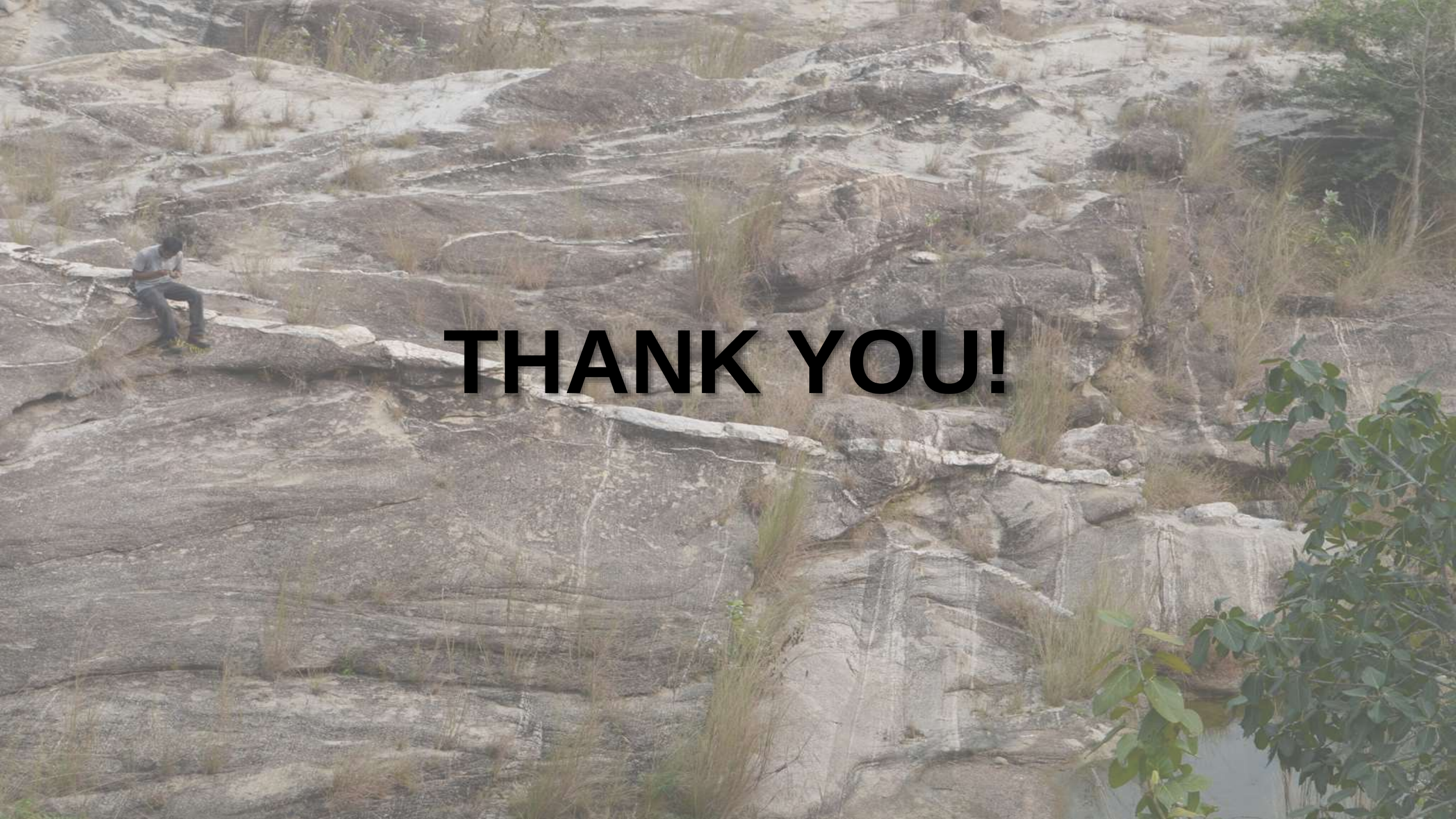
Quartz <0001> pole figures away from the mylonite (left) and in the vicinity of the mylonite (right). Note the transition from a comparatively stronger CPO to a diffuse CPO with a prominent maxima indicative of basal <a> slip

DISCUSSION

- The Remal granite-gneiss mostly preserves its original igneous character despite subsequent metamorphic reworking
- Sedimentary trough cross-beds can develop in felsic igneous rocks too and the processes related to its formation need to be explored further
- Localized mylonitization in response to crustal scale shearing might have led to the development of the gneissosity, or it may have been generated in the solid state during diapir ascent

CONCLUSIONS

- A strong gneissic segregation layering may develop in an initially isotropic granite even at low metamorphic grades, in the greenschist facies
- Such a fabric may develop in response to weak strain localization along spaced mylonitic shear zones related to the far-field effects of crustal-scale shearing
- The preservation of sedimentary cross stratification within the Remal granite-gneiss suggests post-emplacement deformation operated at low grades and was partitioned into localized, narrow shear bands


THANK YOU!