

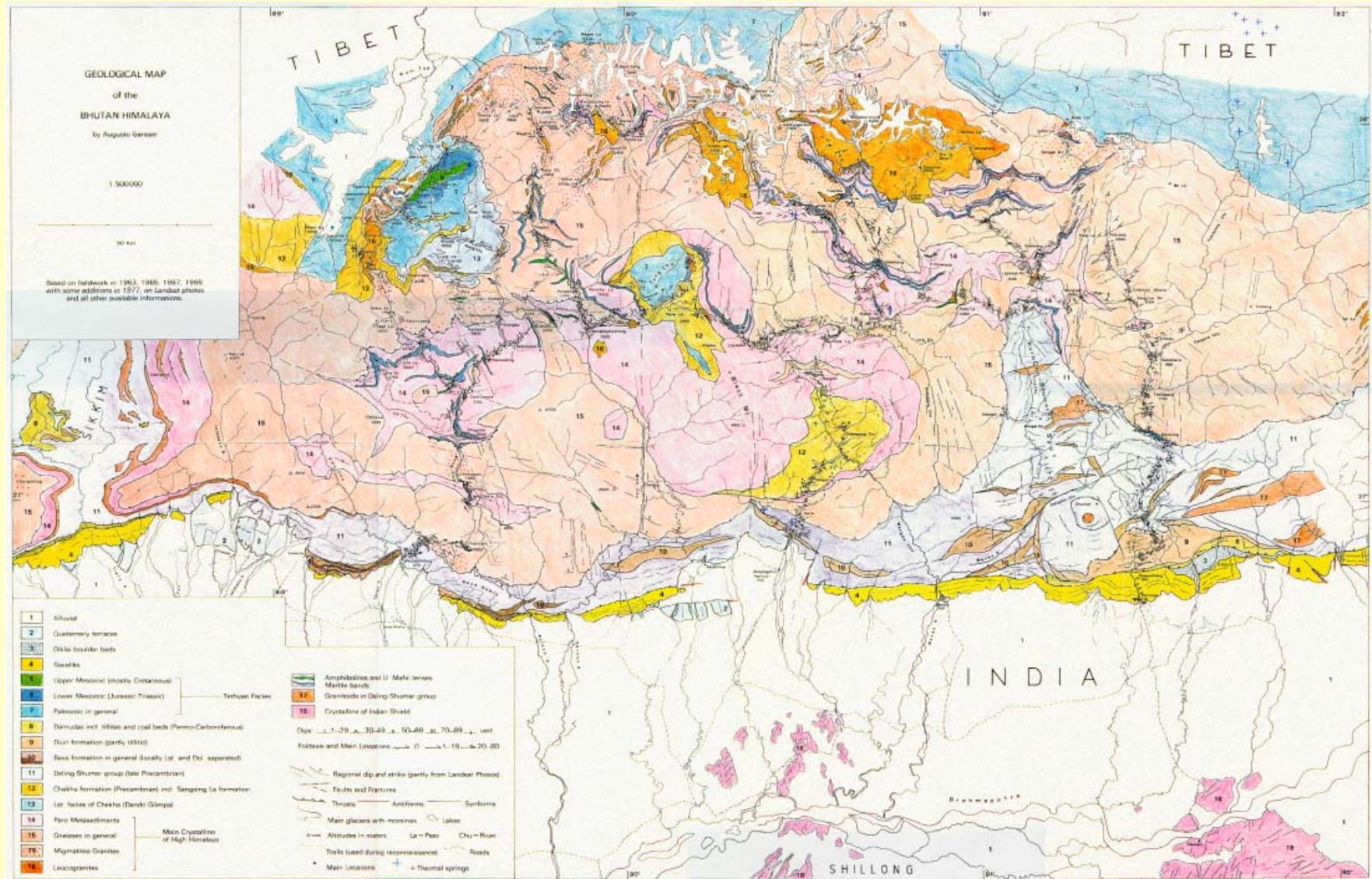
# Bhutan: a magic country with magic geology - metamorphic, structural, thermal and rock magnetic history of the Pele La profile

István Dunkl, Eva Schill and J. Florian Wellmann



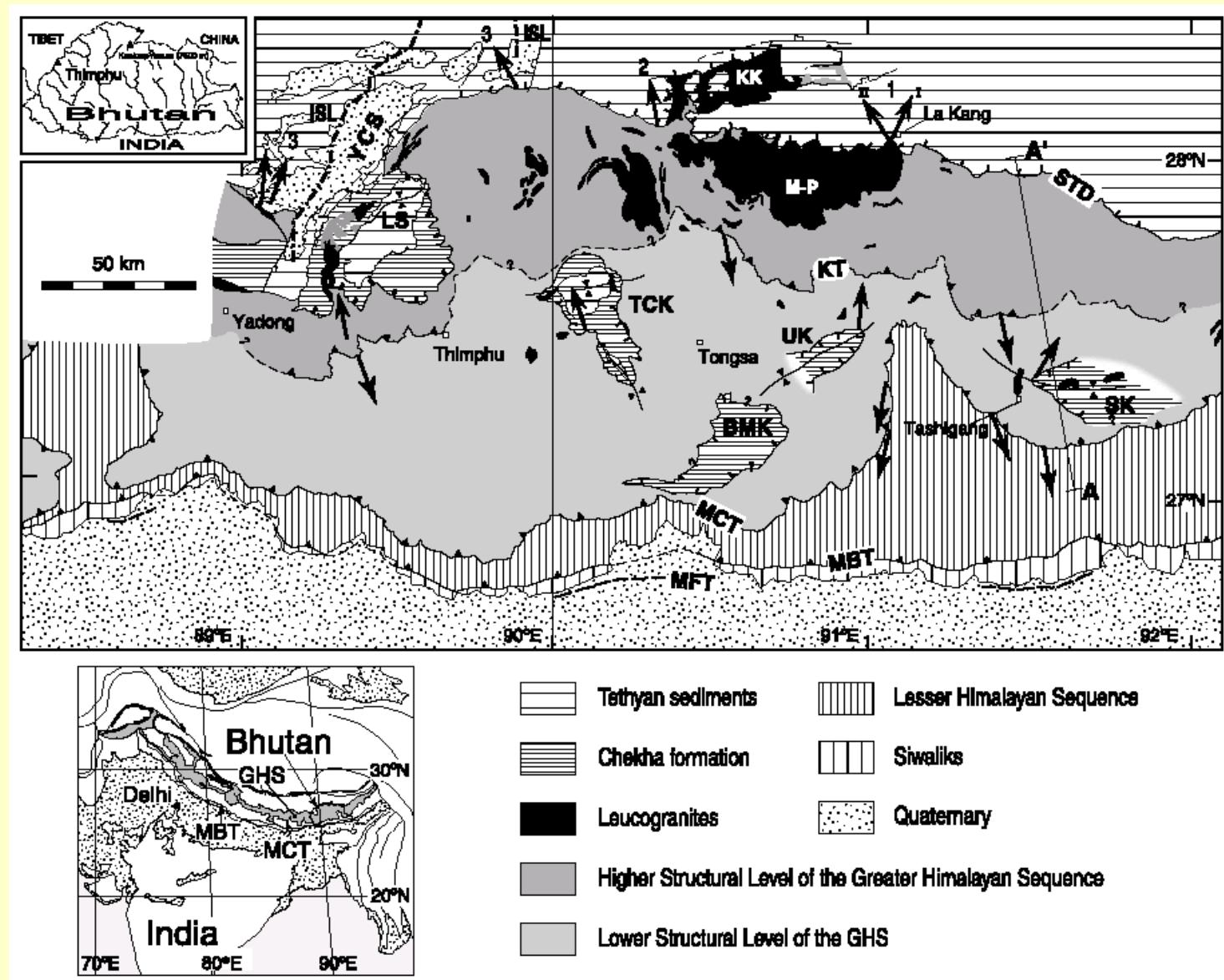
Palaeomagnetic sampling along them major highway of the country

# Geology



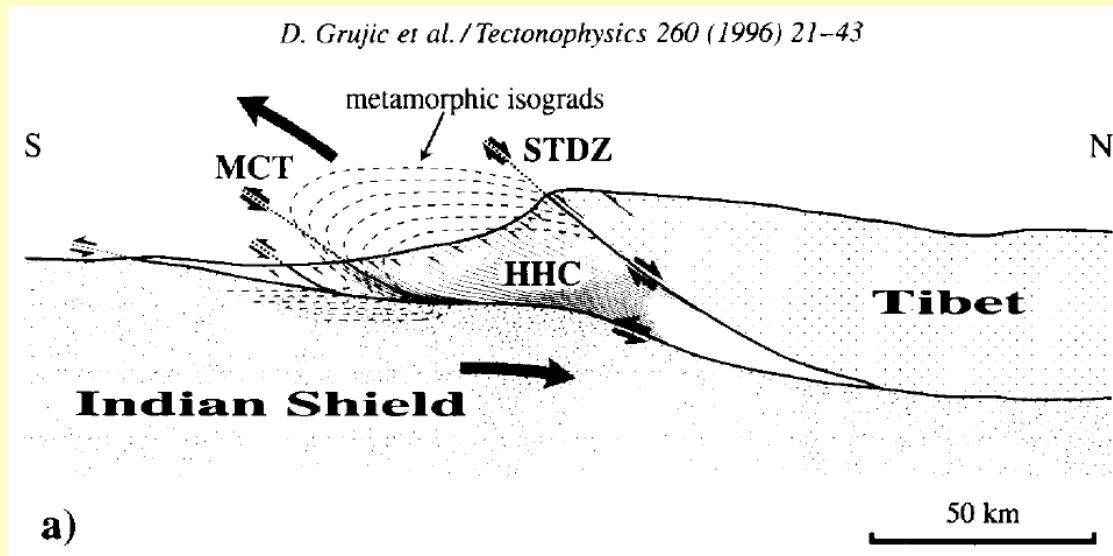
[Gansser, Geology of the Bhutan Himalaya, 1983]

# Geology



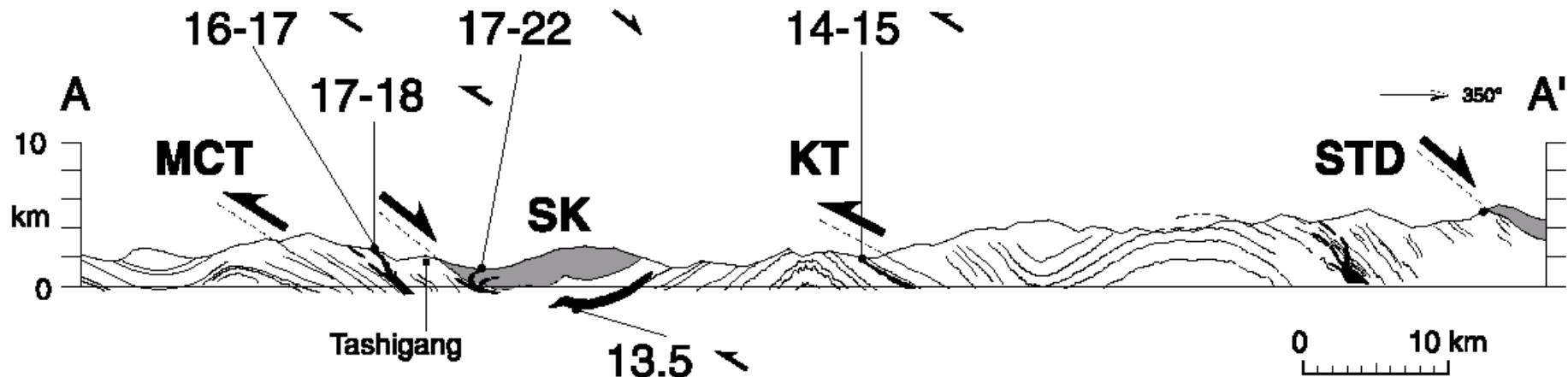
Simplified geological map of Bhutan [Grujic et al., 2002]

# Geology



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D. Grujic et al. / Earth and Planetary Science Letters 198 (2002) 177–191



# Geology, concept of thermo remanent rock magnetism

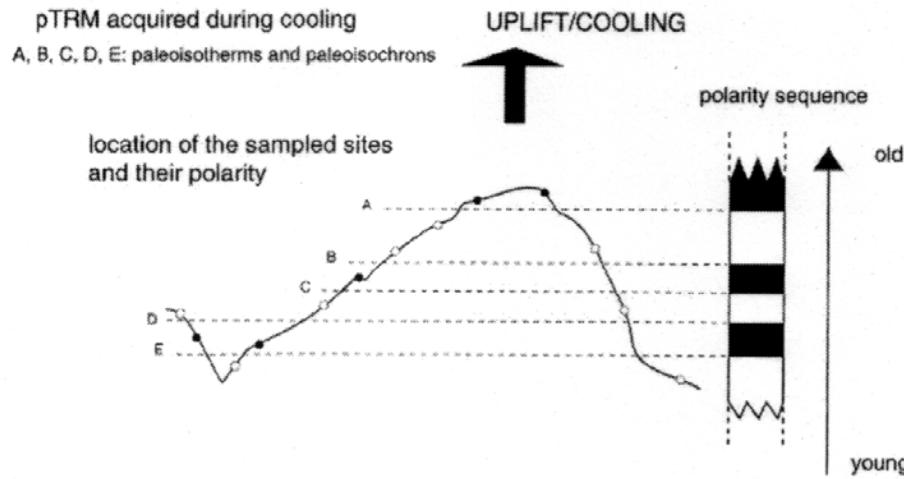
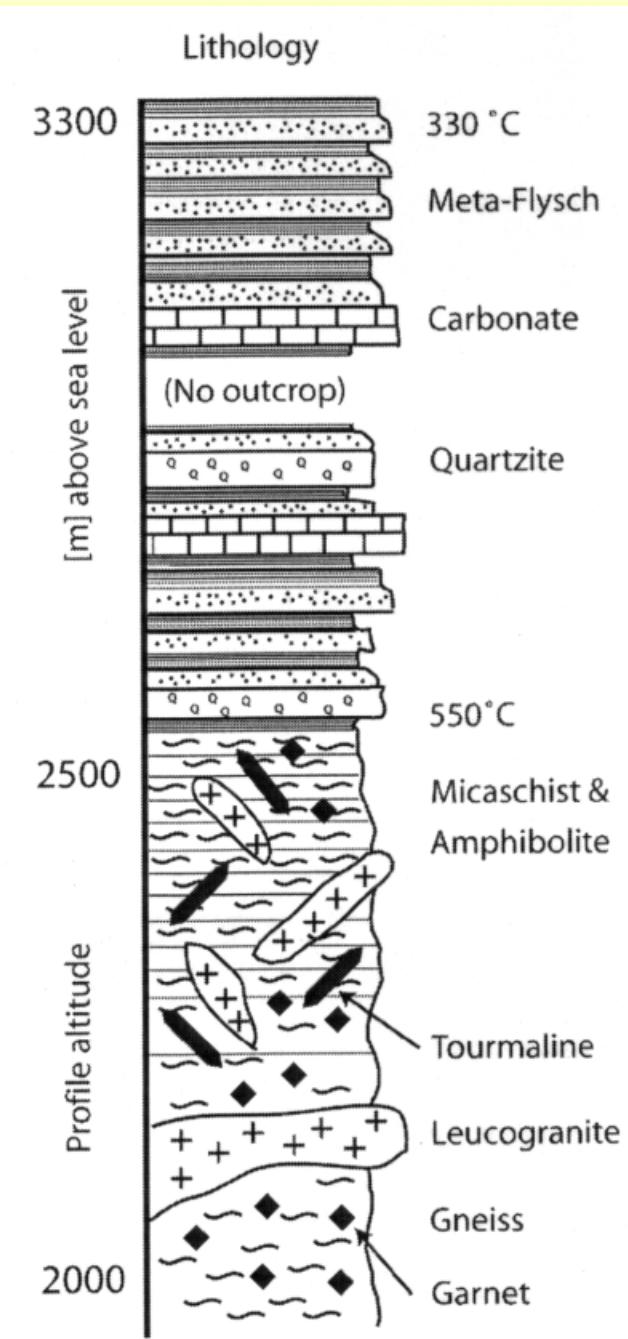


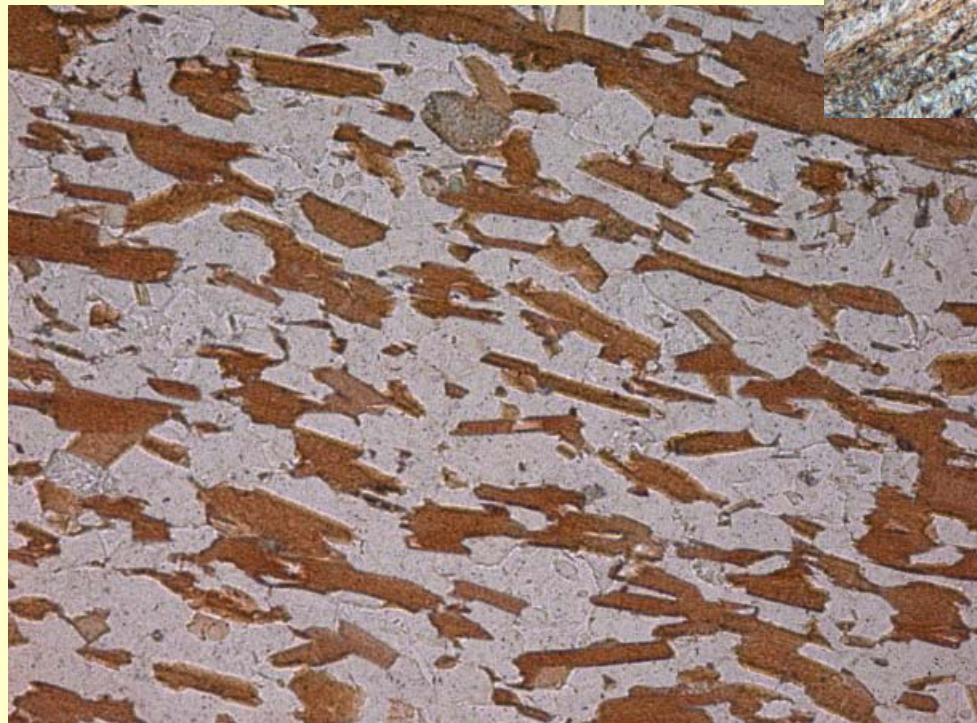
Figure 17: Successive pTRM acquisition model

Model for the acquisition of pTRM during uplift and cooling by Crouzet et al. (2001a). Indicated in the figure are sample sites and interpreted polarity sequence. Notable is the younging of remanences towards the bottom.

[Wellmann, 2004]

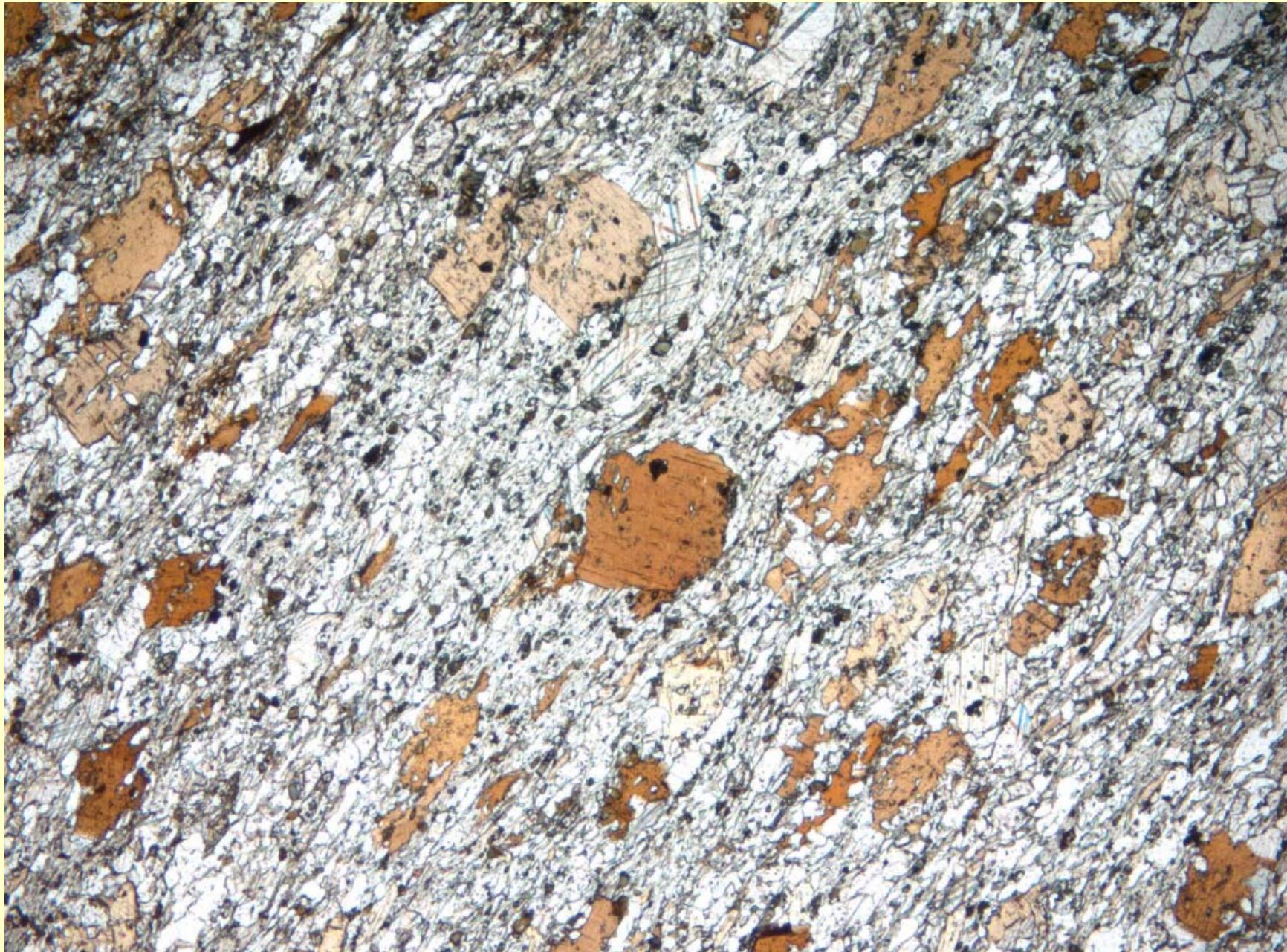


**Fine, laminated clayey and sandy metasediment with crenulation and oblique schistosity**

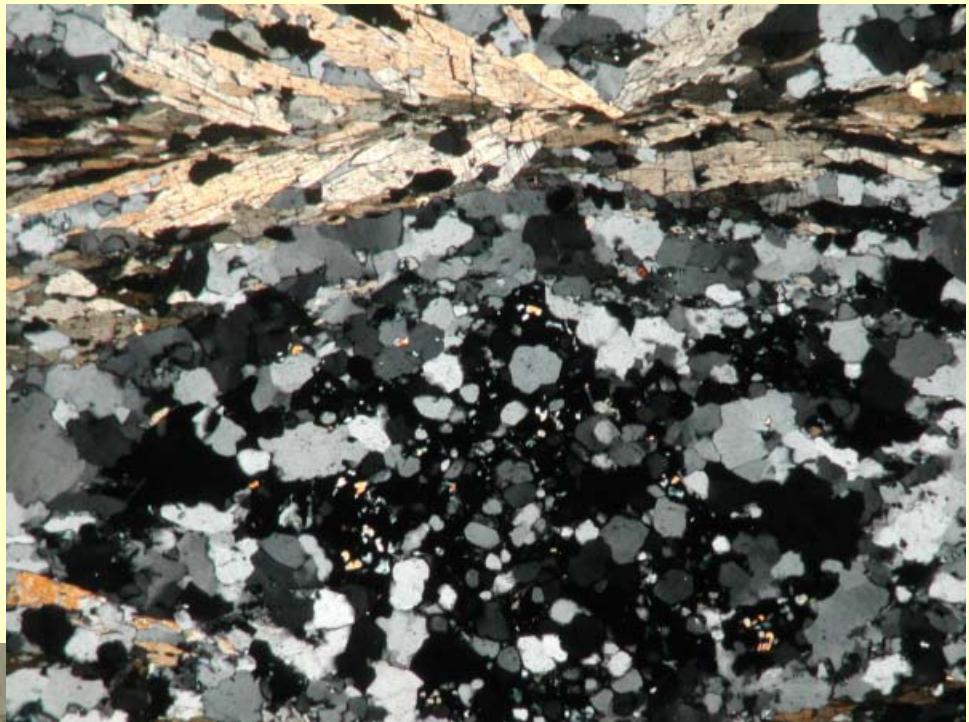


**Biotite schist with well developed crystals**

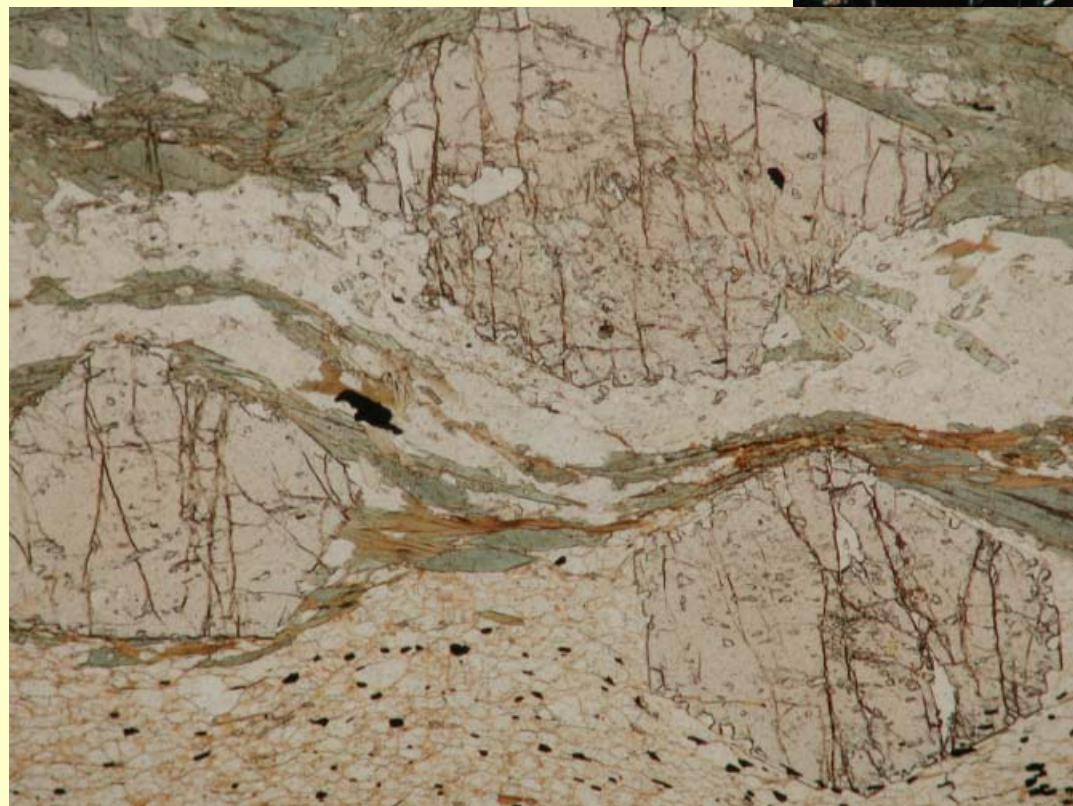
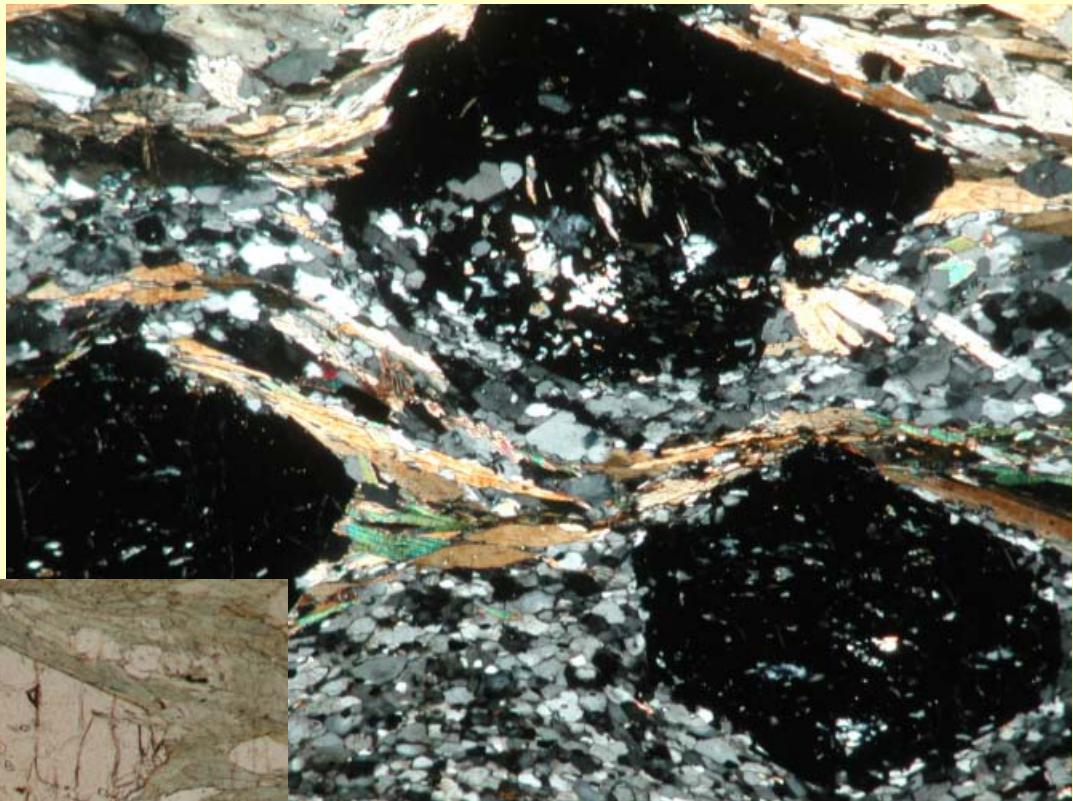
Orientations of bioties and the schistosity indicate two overprint phases



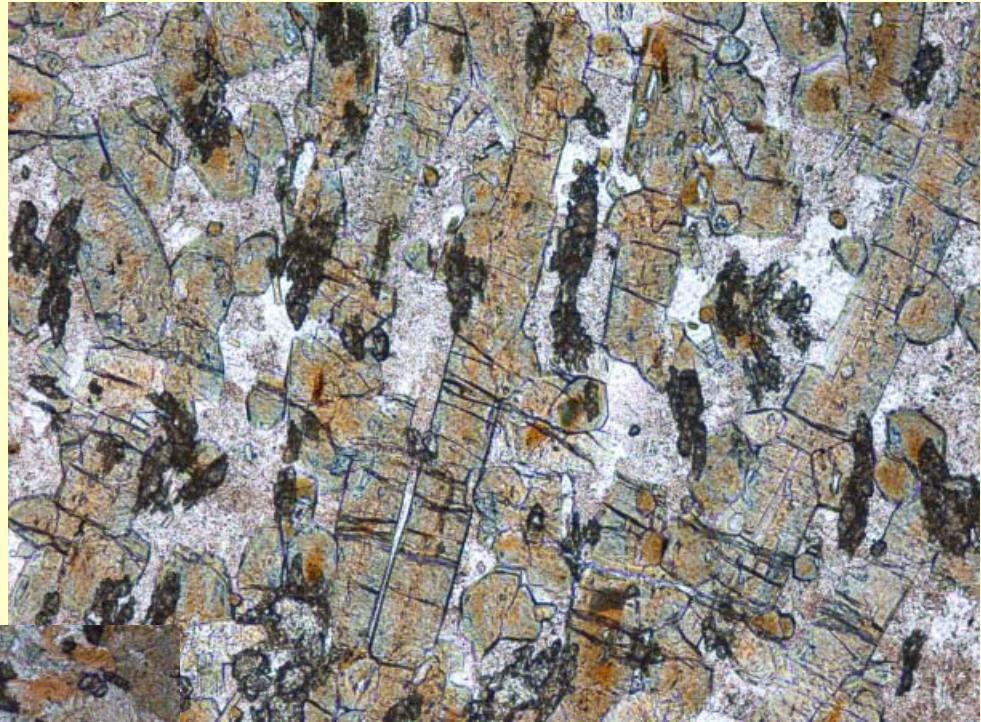
## Skeletal garnet



## Euhedral garnets in the garnet-amphibolite



## Tourmalinite

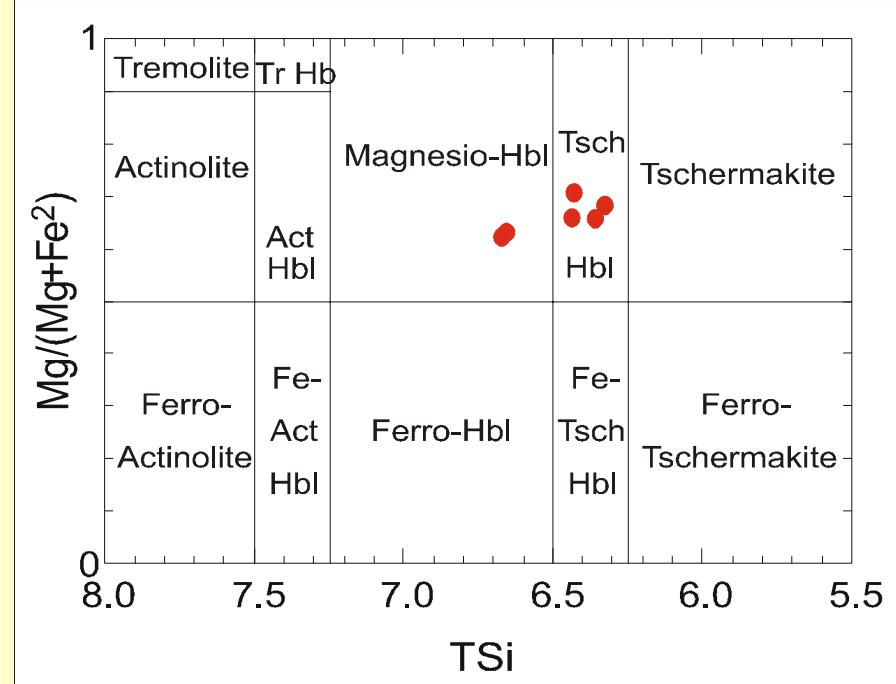


**Tourmaline growth (metasomatism)  
postdates the folding**

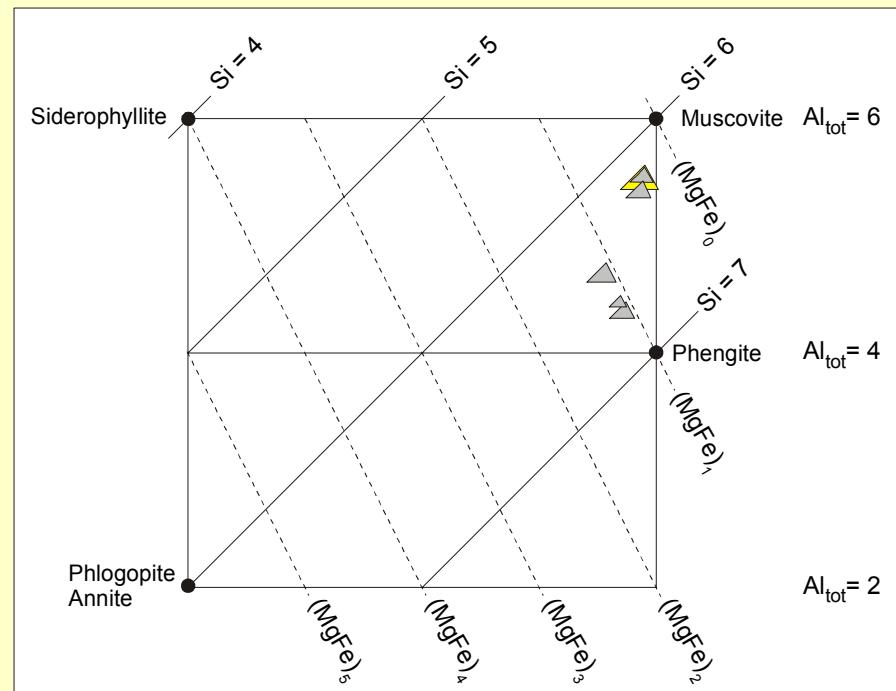
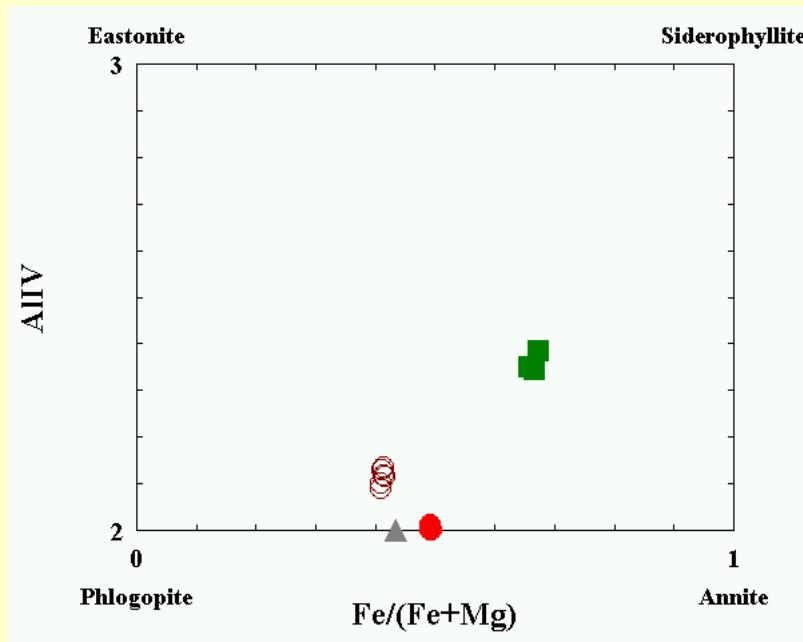
# Mineral chemistry

*amphibole*

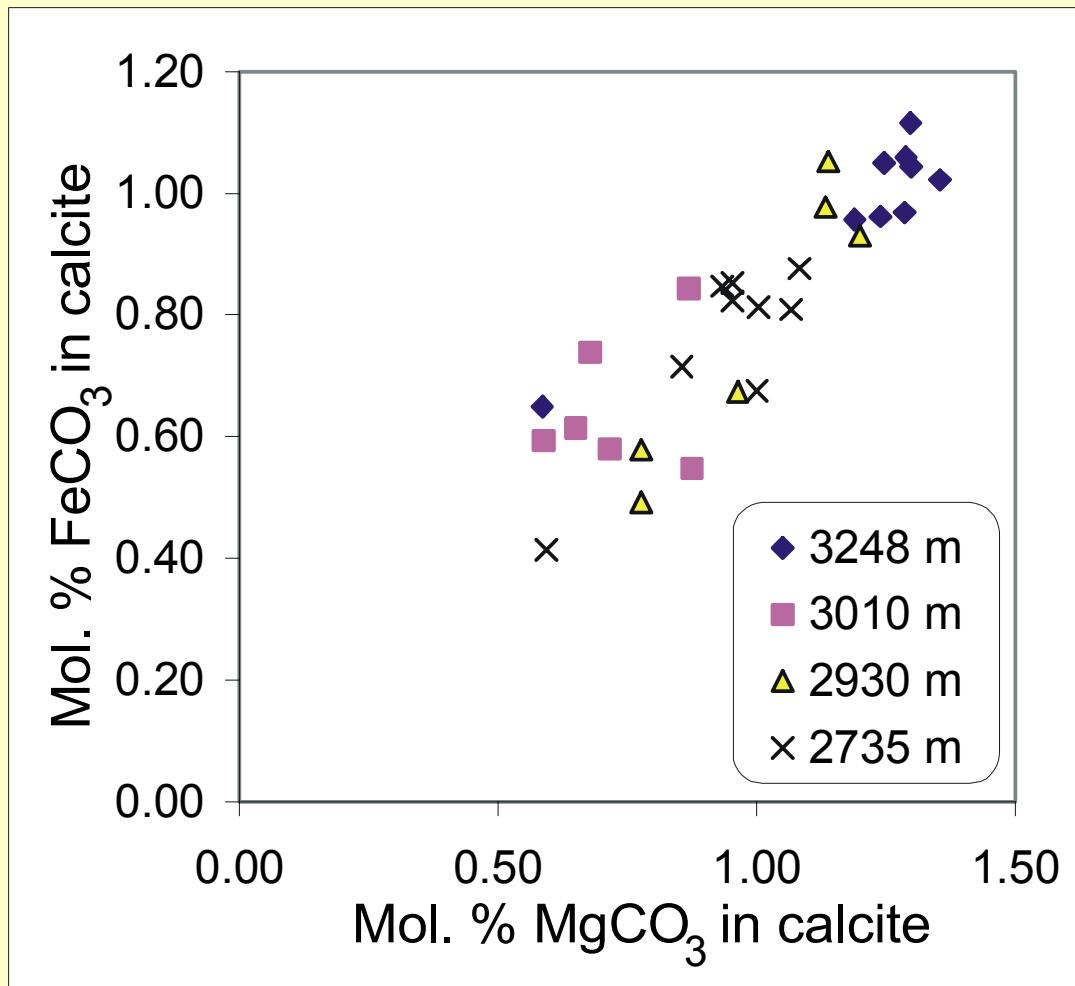
*biotite*



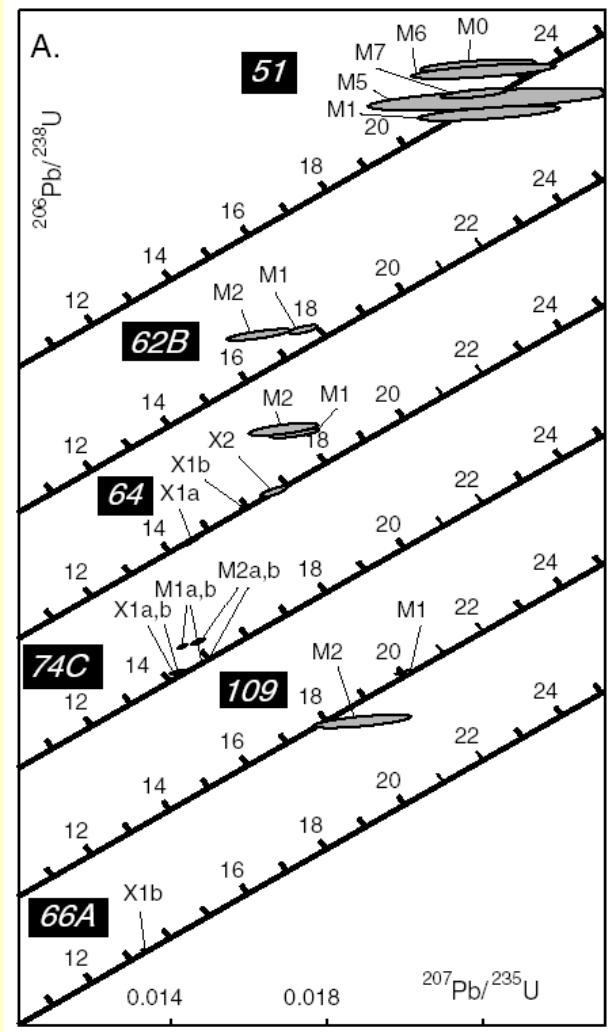
*white mica*



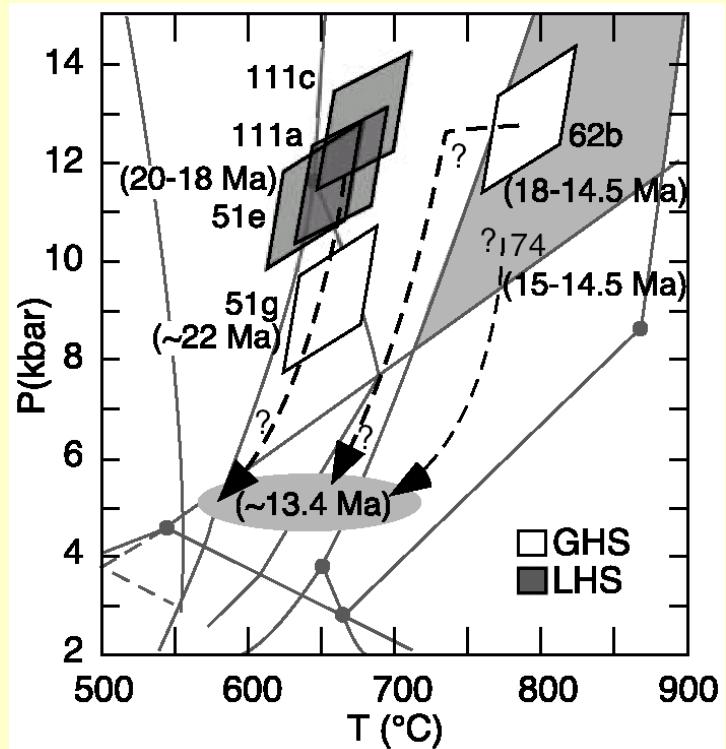
**Mg and Fe in the calcite of the marbles. The higher values mean higher peak metamorphic conditions, but the bulk chemistry plays also some role**



## U/Pb concordia plots for samples from eastern Bhutan



**Summary P-T-t diagram showing monazite & xenotime ages and estimated peak metamorphic conditions for the uppermost Lesser Himalayan rocks of E. Bhutan**



[Daniel et al., 2003]

## Relation of elevation and radiometric ages

