STRUCTURAL AND TECTONIC FEATURES OF THE WESTERN PART OF CARPATHO-BALKANIDES : EVIDENCE FROM PALAEOSTRESS ANALYSIS OF RAVANICA AREA

Dušan Jelić,
Geological Institute of Serbia, Belgrade

Branislav Trivić,
Belgrade University - Faculty of Mining and Geology, Belgrade

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OBJECTIVE

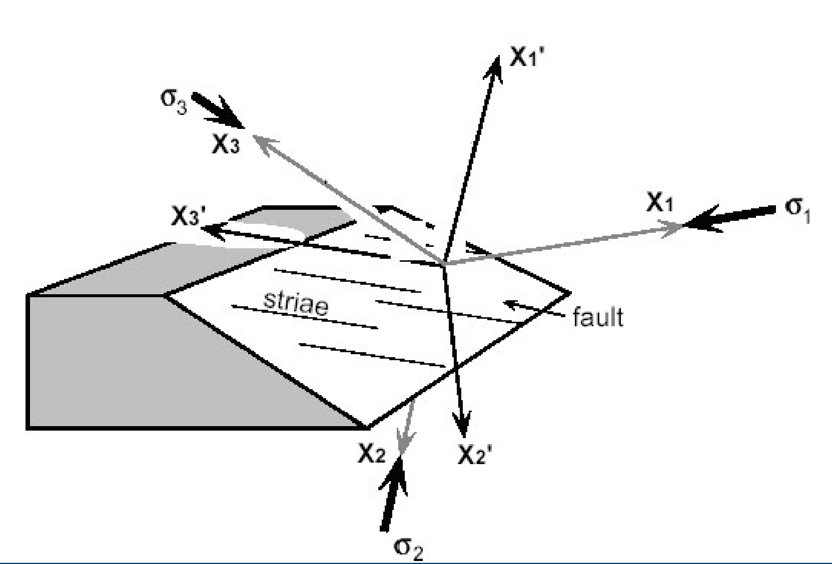
Palaeostress analysis based on conjugate shear zone pattern of Ravanica area

EXPECTED RESULTS

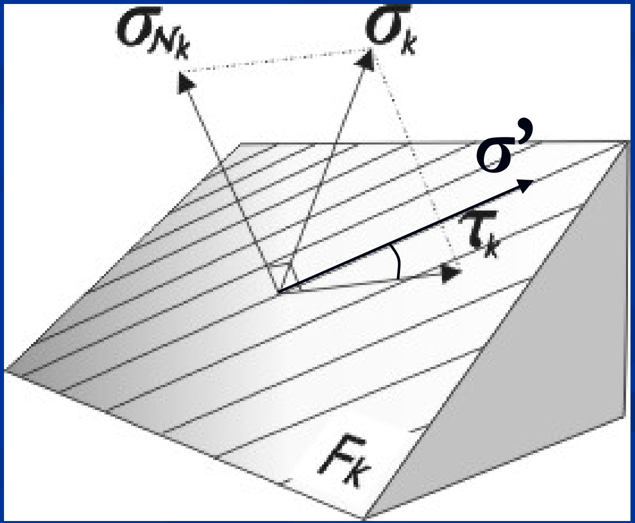
Determination of main kinematic events with its regimes and maximum stress orientation

METHODOLOGY

- A straightforward solution to the problem of finding the stresses causing slip on a set of faults is to assign a simple shear stress state at each fault, with the intermediate principal stress lying in the fault plane perpendicular to the slip direction.
- The local stress tensors then can be averaged together to give an estimate of the regional stress tensor.
- The angle between the maximum principal stress and the fault plane can be varied to search for the minimum deviation between the faults in the set.



σ_1 σ_2 σ_3 = axis of stress calculated for the set of faults
x_1, x_2, x_3 = axis of stress measured in the field



$$\sigma' - \tau_k \rightarrow 0$$

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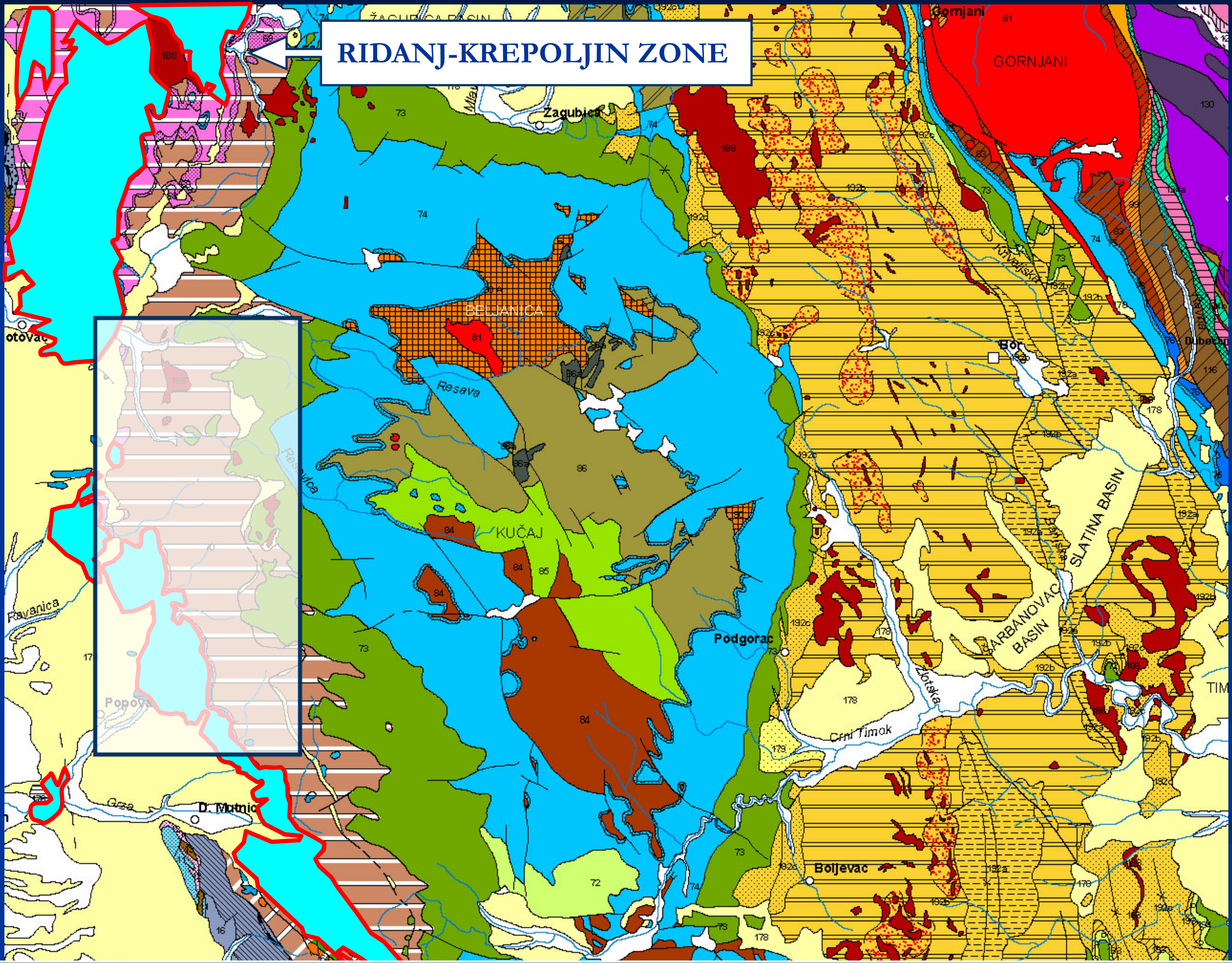

GEOLOGICAL MAP OF CARPATHO-BALKANIDES by H.G.Kräutner & B.Krstić 1996

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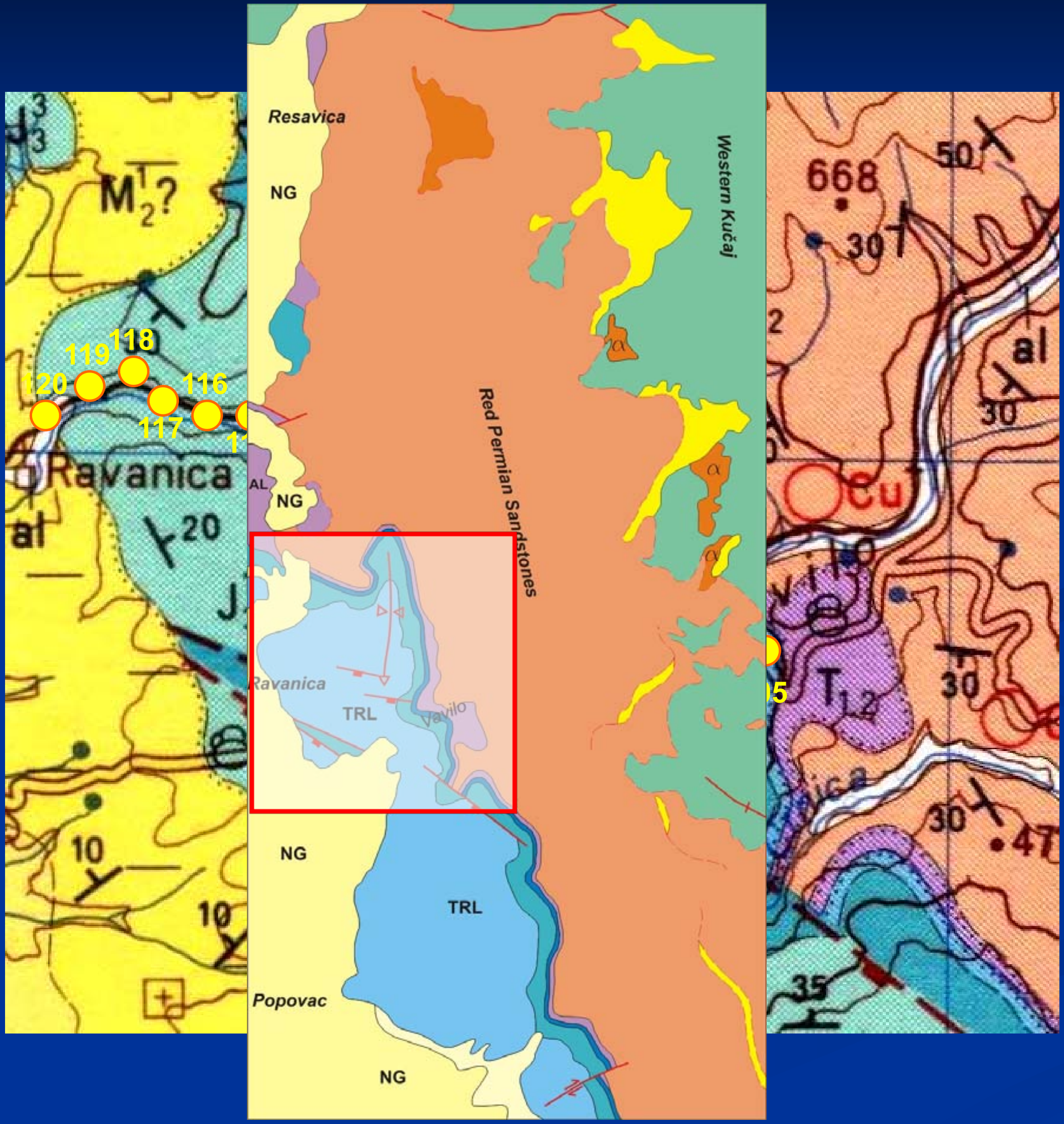

- Morava basin neogene sediments
- Titonian rief limestones
- Late jurassic limestones with chert
- Middle jurassic sandy limestones
- Anisian limestones
- Red permian sandstones
- Observation points

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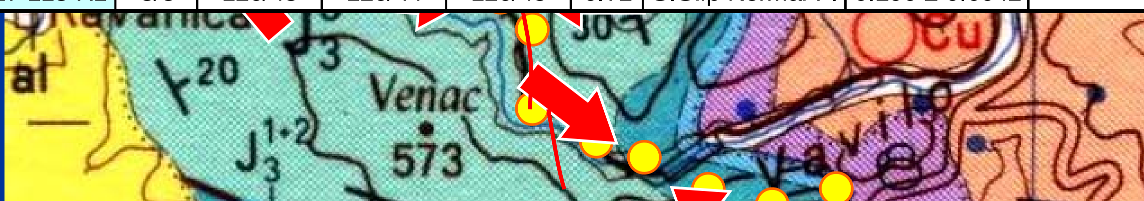
RESULTS

OBSERVATION POINT	PLANES/ LINEATIONS	PRINCIPAL STRESS DIRECTION MAXIMUM σ_1	PRINCIPAL STRESS DIRECTION INTERMEDIATE σ_2	PRINCIPAL STRESS DIRECTION MINIMUM σ_3	STRESS RATIO	REGIME	MEAN SHEAR STRESS ± STRESS DEVIATION	PRINCIPAL SHORTENING/ EXTENSION
108 R3	7/10	140/35	140/36	140/37	0.50	Strike-Slip	0.417 ± 0.001	84/19
111 R1	6/9	69/46	319/18	214/38	0.45	Normal Faulting	0.340 ± 0.016	49/3
112 R1	6/10	252/86	252/87	252/88	0.72	Normal Faulting	0.211 ± 0.002	343/20
117-118 R1	8/8	126/43	126/44	126/45	0.72	S.Slip-Normal F.	0.296 ± 0.0042	



FIRST DEFORMATION STAGE

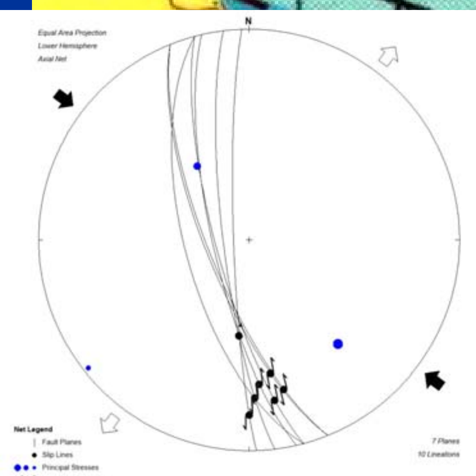
Oldest deformation stage – app. 100 m.a. Austrian Stage of Early Alpine Orogenesis

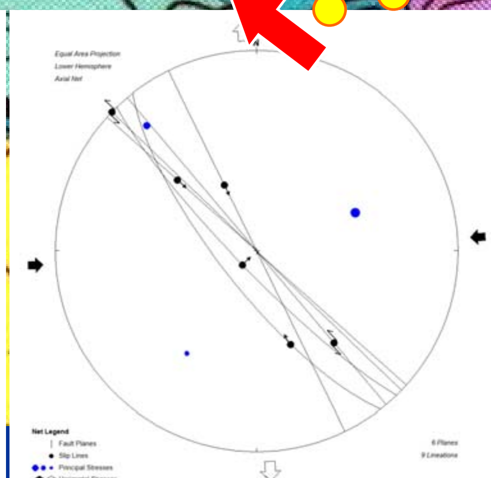
Weakly exposed in the field

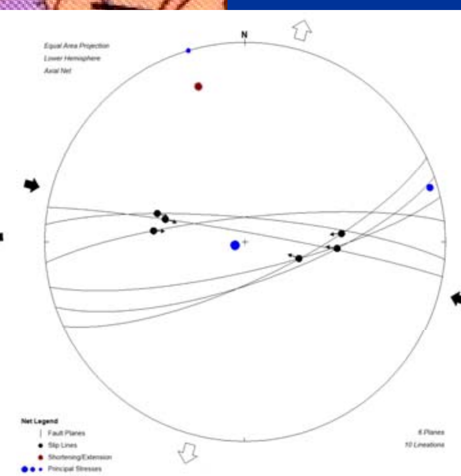
WSW – ENE oriented max. stress

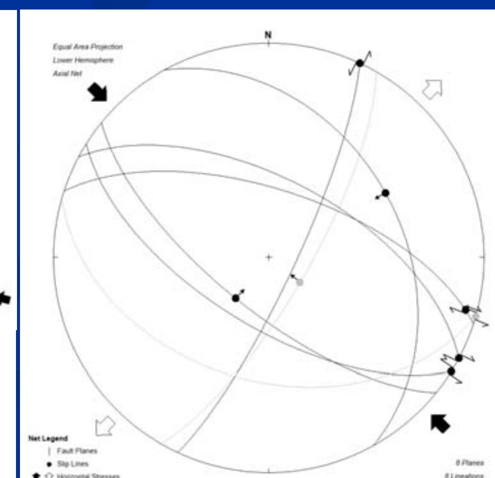
65 measurements for Tensor calculation

Shortening with predominant eastward Nappe stacking









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R E S U L T S

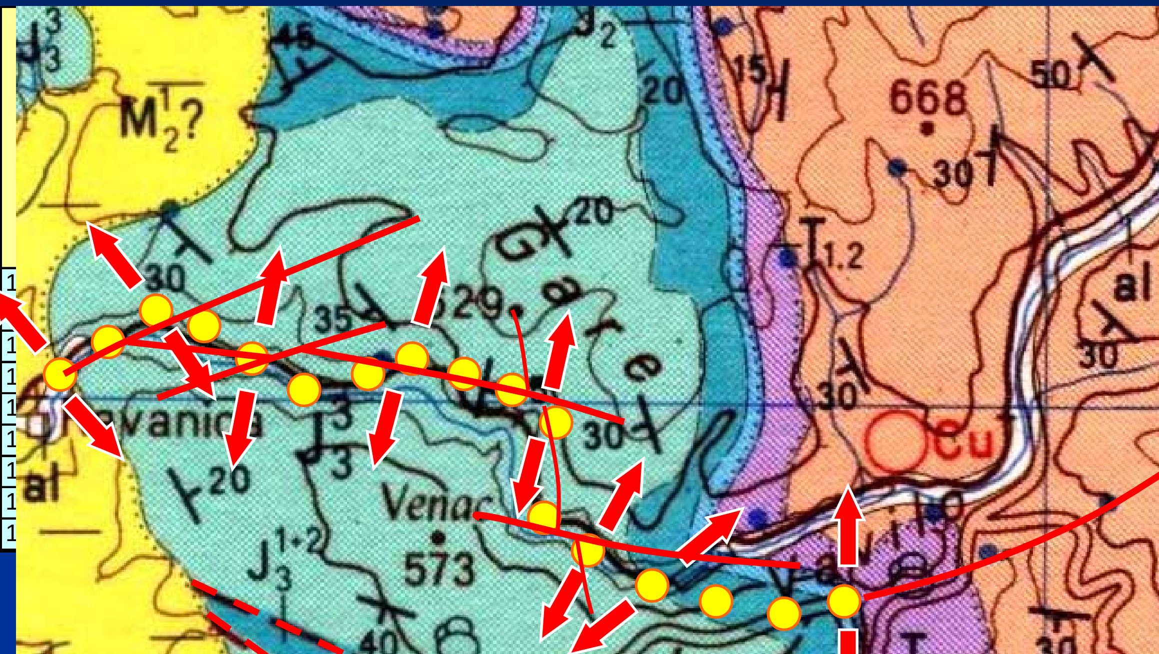
SECOND DEFORMATION STAGE

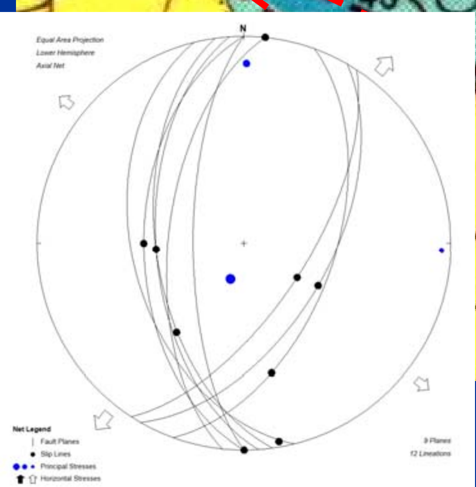
During Late Cretaceous (Turonian – end of Maastricht) – app. 90-65 m.a. Early Alpine Orogenesis

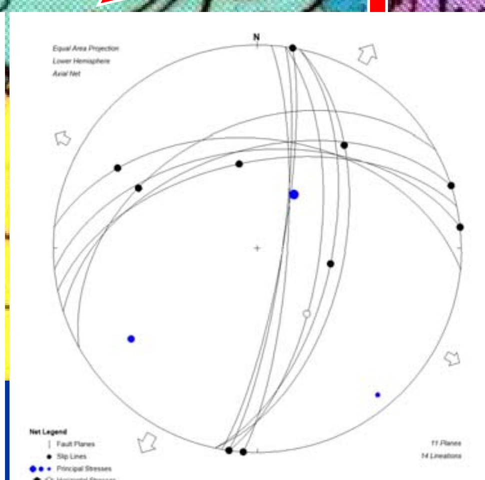
Extension with NNE – SSW orineted max. stress, with local stress distribution trending SW - NE and WNW - ESE

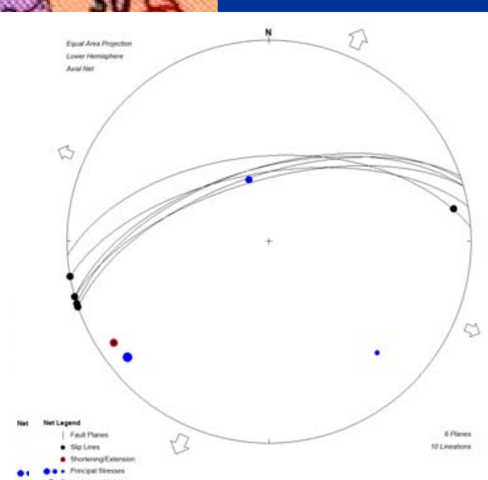
Strong regime of normal faulting and subordinate sinistral strike slip regime

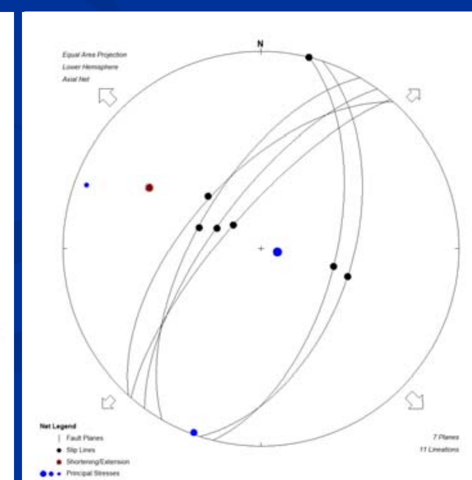
179 measurements for Tensor calculation











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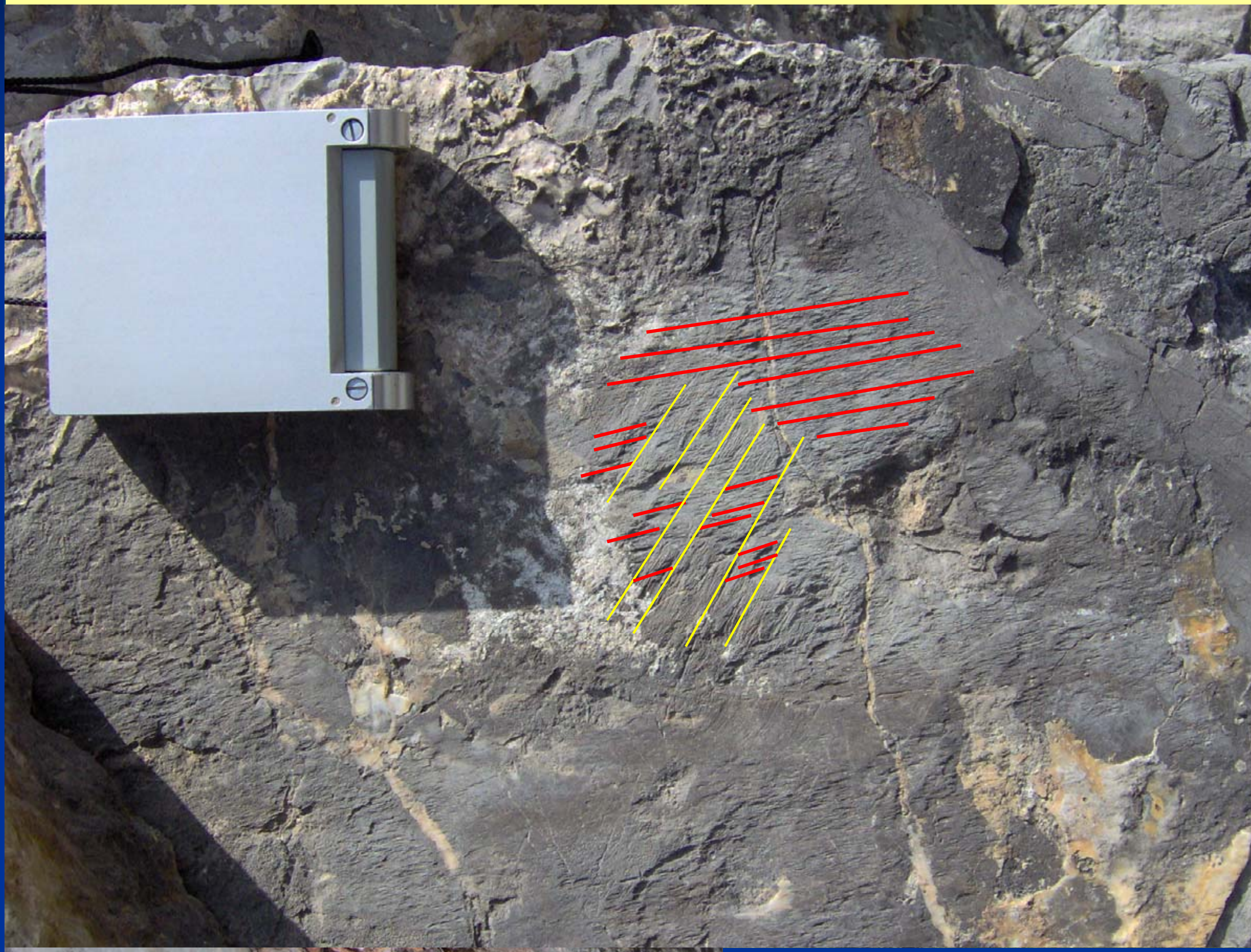
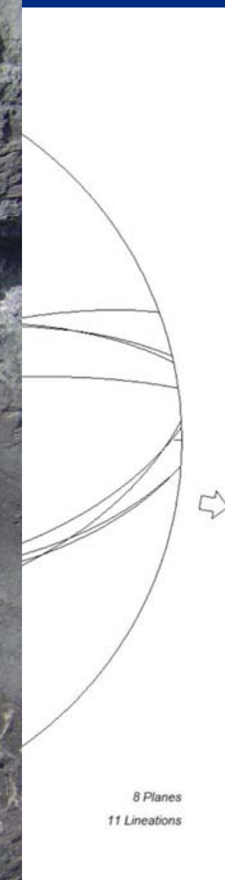
SECOND DEFORMATION STAGE – FIELD OBSERVATIONS





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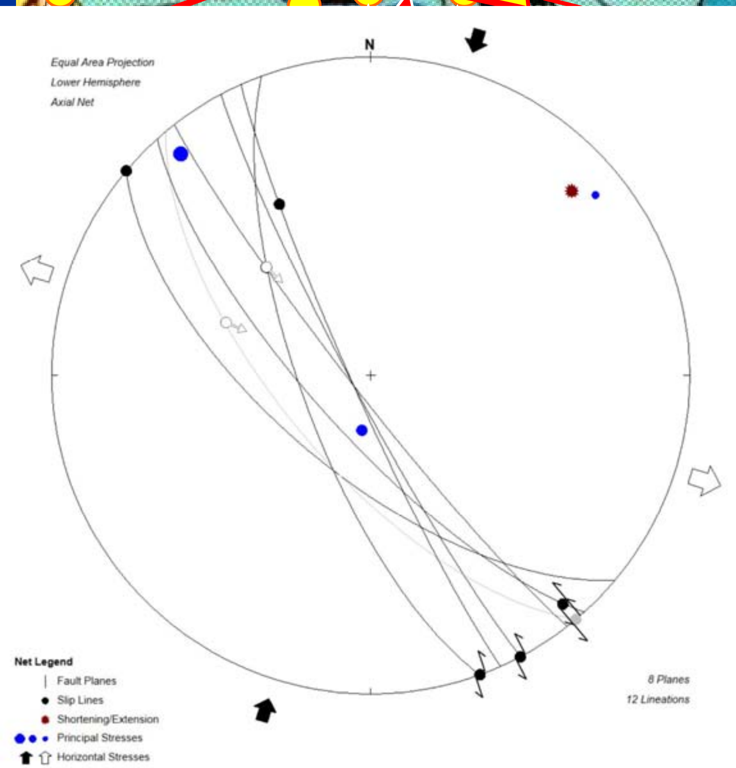
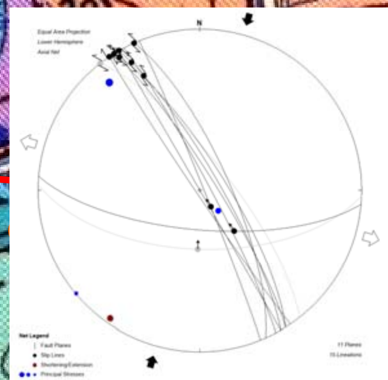
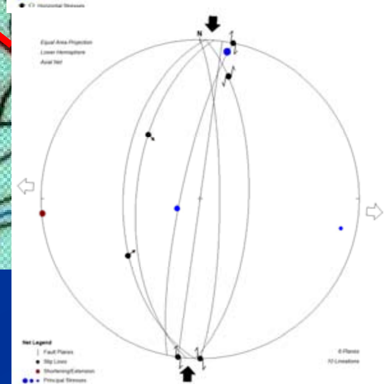
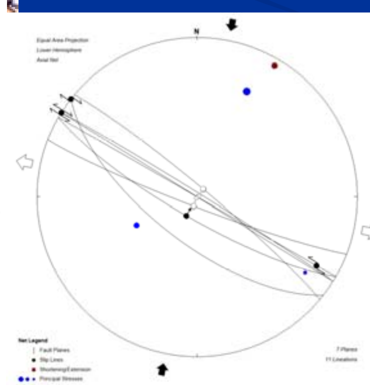
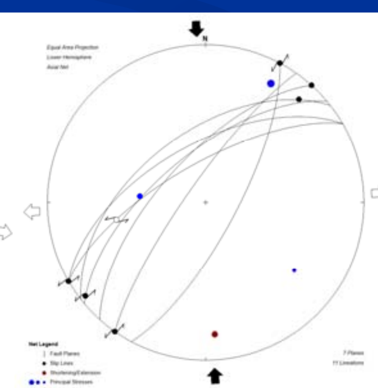
OBSERVATION POINT	PLANES/ LINEATIONS	PRINCIPAL STRESS DIRECTION MAXIMUM σ1	PRINCIPAL STRESS DIRECTION INTERMEDIATE σ2	PRINCIPAL STRESS DIRECTION MINIMUM σ3	STRESS RATIO	REGIME	MEAN SHEAR STRESS ± STRESS DEVIATION	PRINCIPAL SHORTENING/ EXTENSION
110 R1+R2	11/15	320/14	138/76	230/0	0.70	S.Slip-Normal F.	0.073 ± 0.024	215/4
112 R2	6/10	10/7	249/77	102/11	0.66	S.Slip-Normal F.	0.111 ± 0.011	265/1
113 R1	8/12	319/9	189/[illegible]	51/11	0.61	S.Slip-Reverse F.	0.071 ± 0.037	47/15
114 R1	7/11	25[illegible]8	245[illegible]6	125/19	0.79	S.Slip-Reverse F.	0.038 ± 0.009	30/5
115 R1	7/11	29[illegible]5	275/56	128/30	0.54	Strike-Slip	0.014 ± 0.026	176/17











RESULTS

THIRD DEFORMATION STAGE

Early Paleocene – app. 64 m.a. Laramide Stage of Early Alpine Orogenesis

Shortening with NNE – SSW orineted max. stress

Sinistral Strike – Slip regime and subordinate reverse faulting

98 measurements for Tensor calculation

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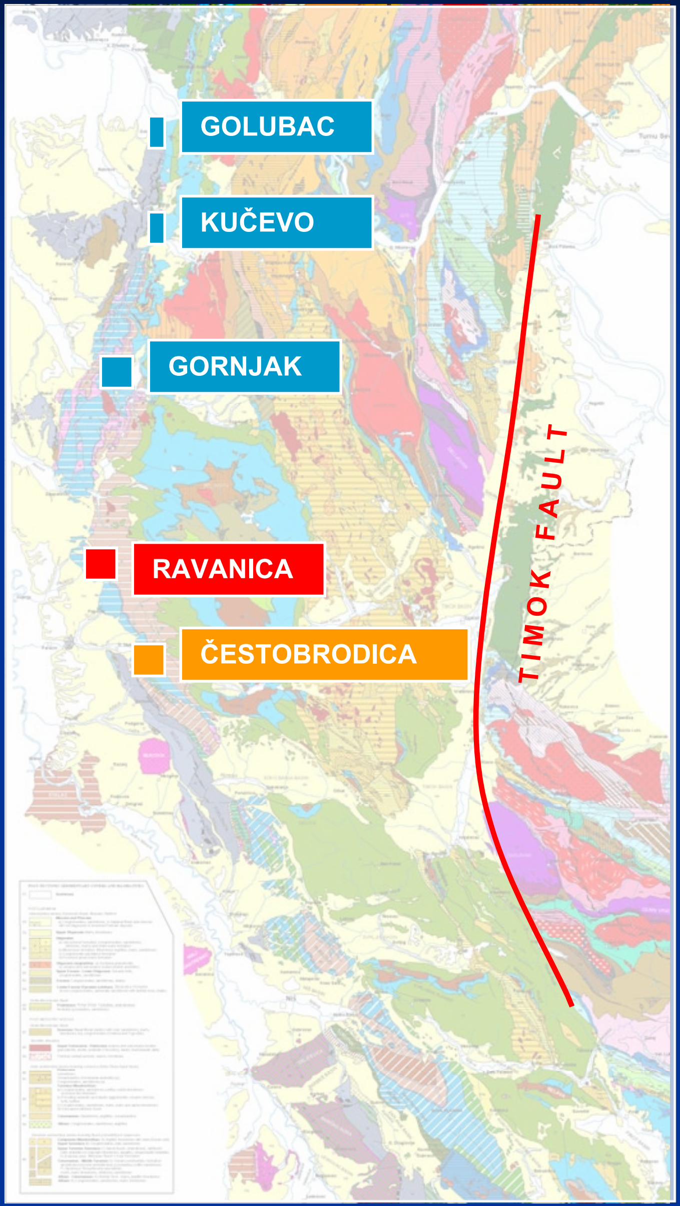

CONCLUSION

- Three main kinematic events
- Estimated principal stresses, regimes and orientation
- Estimated time of kinematic events

FUTURE INVESTIGATIONS

- Palaeostress analysis of Čestobrodica, Gornjak, Kučevo, Golubac Areas (western rim of Carpatho-Balkanides)
- Fission track analysis of investigated areas – apsolute time of kinematic events
- Palaeostress analysis combined with statistical analysis of brittle structures of the eastern rim of Carpatho-Balkanides, towards Timok fault