Magnetostratigraphy and Rotation of Pleistocene-Miocene Sedimentary Rocks in the Western Salton Trough, CA.

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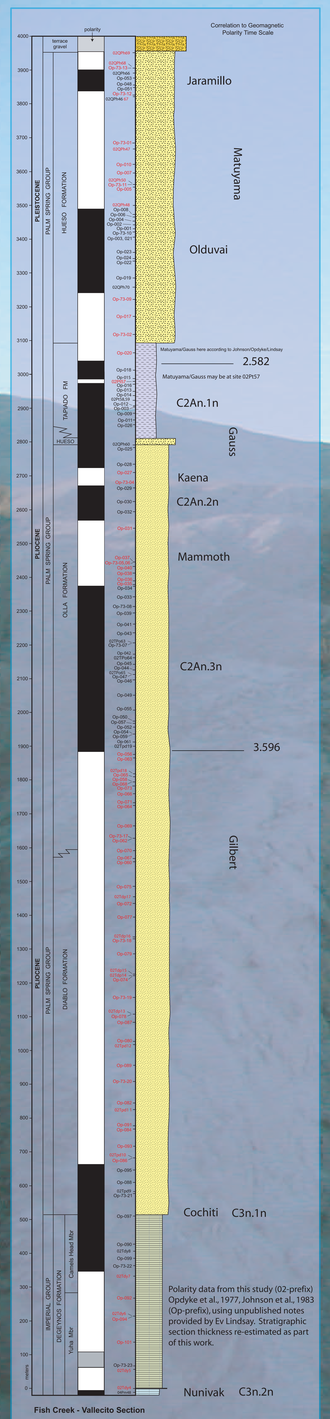
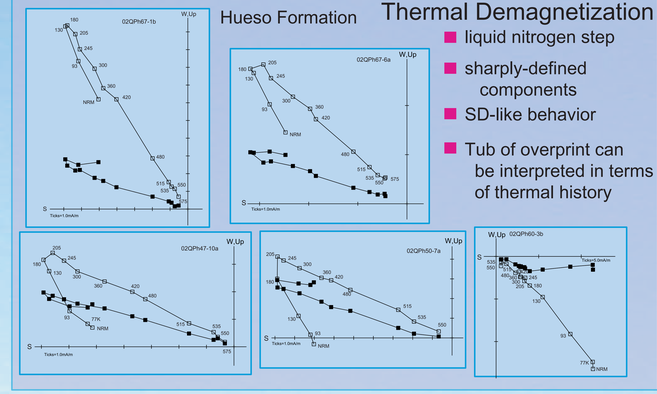
Fish Creek Vallecito Basin



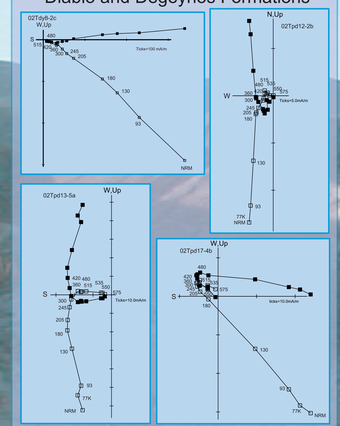
Thermal Demagnetization

- liquid nitrogen step
- sharply-defined components
- SD-like behavior
- Tub of overprint can be interpreted in terms of thermal history

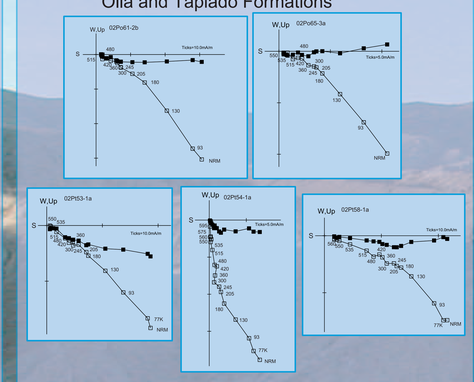
Hueso Formation



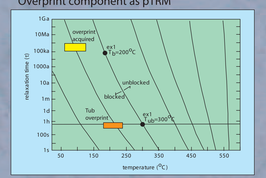
Diablo and Degeynos Formations



Olla and Tapiado Formations



Overprint component as pTRM



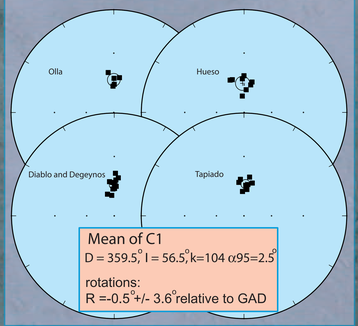
Following Dunlop et al., 1997, sharply-defined magnetization components with narrow (and consistent) unblocking temperature ranges suggests SD-like pTRM, not CRM as origin of overprint.

Fish Creek-Vallecito Basin rocks have C1 Tub in 180-225 C range

suggests C1 acquired at ~100 C, for ~500 ka

C1 component direction represents ~500 ka field average

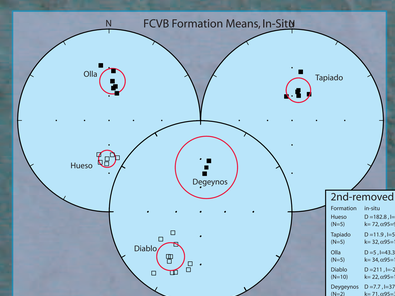
1st-removed components



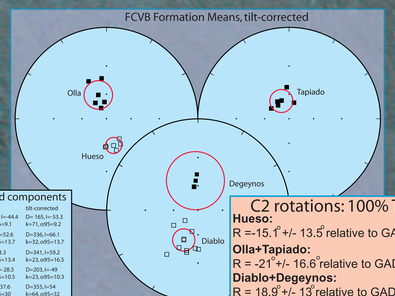
Mean of C1
D = 359.5°, I = 56.5°, k=104 α95=2.5°

rotations:
R =-0.5°+/- 3.6° relative to GAD

FCVB Formation Means, In-Situ



FCVB Formation Means, tilt-corrected



2nd-removed components

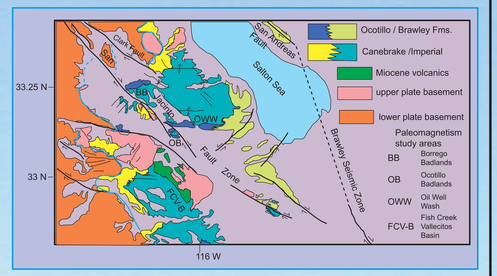
Formation	in-situ	tilt-corrected
Hueso (N=5)	D =182.8, I=-44.4 k= 72, α95=9.1	D= 165, I=-53.3 k=71, α95=9.2
Tapiado (N=5)	D =11.9 , I=-52.6 k= 32, α95=13.7	D=336, I=66.1 k=32, α95=13.7
Olla (N=5)	D =5, I=43.3 k= 34, α95=13.4	D=341, I=59.2 k=23, α95=16.5
Diablo (N=10)	D =211, I=-28.5 k= 22, α95=10.5	D=203, I=-49 k=23, α95=10.3
Degeynos (N=2)	D =7.7, I=37.6 k= 71, α95=35	D=355, I=-54 k=64, α95=32

C2 rotations: 100% TC

Hueso:
R =-15.1° +/- 13.5° relative to GAD

Olla+Tapiado:
R = -21° +/- 16.6° relative to GAD

Diablo+Degeynos:
R = 18.9° +/- 13° relative to GAD



Rotation models

- utilize GPS, plate motions, fault orientations, and creep/rheology models
- fault-creep estimates are important
- models make specific predictions of long-term rotation rates

FCVB predicted rotation rates:
McCaffrey, 2005: 0.5°/Ma CW
Bos & Spakman, 2005:
mod I:6-8°/ Ma CW
mod II: 1-2°/Ma CW

Bos and Spakman, 2005

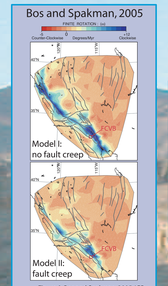


Figure 8, Bos and Spakman, 2005 JGR

McCaffrey, 2005

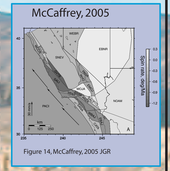
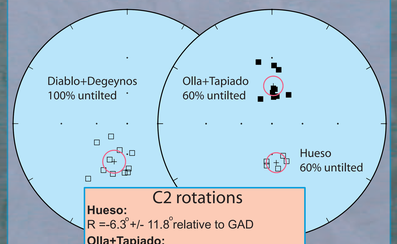


Figure 14, McCaffrey, 2005 JGR

2nd-removed components

Optimal tilt-correction:
maximum k, Inclination closest to Ix



C2 rotations

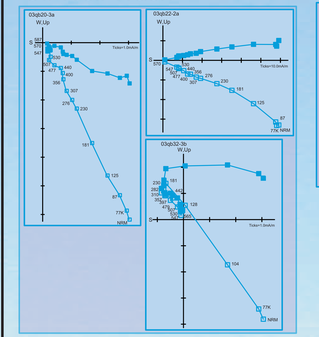
Hueso:
R =-6.3° +/- 11.8° relative to GAD

Olla+Tapiado:
R = 2.1° +/- 13.7° relative to GAD

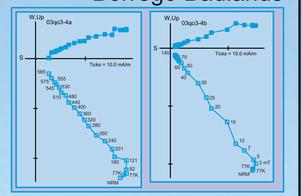
Diablo+Degeynos:
R = 18.9° +/- 13° relative to GAD

Upper sections: Borrego Badlands, Oil Well Wash

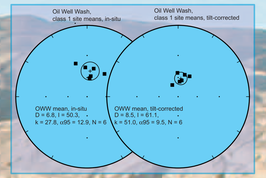
Oil Well Wash

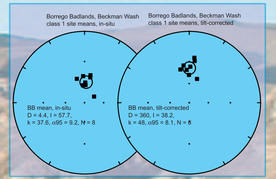


Borrego Badlands

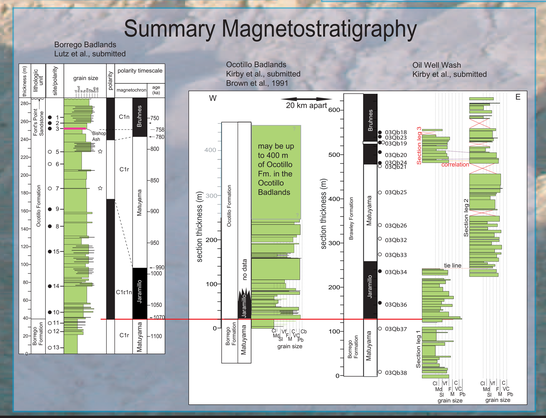


Bishop Ash, Site 03qo3, Borrego Badlands

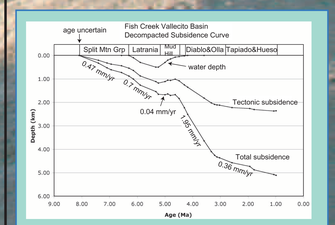




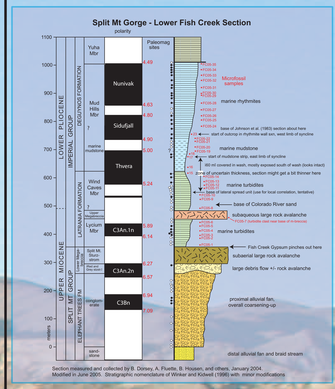
Summary Magnetostratigraphy

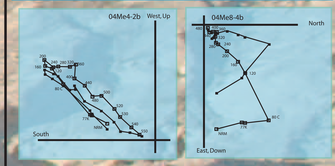


Basin Subsidence



lower section: Split Mtn. Gorge





FCVB section Conclusions:

Sedimentary rocks of Fish Creek -Vallecito basin have well-defined magnetization components

Analysis of 1st-removed components as pTRMs has promise as test for young rotations, at 95% confidence, the detection threshhold will be rotations > 3.6° (rates > 4.7°/Ma)
Such analyses can test high rotation rates predicted by "no fault creep" models

For the FCVB rocks, C1 directions indicate rotation R= -0.5°+/-3.6°
maximum CW rotation rate limited to 4° to 6° during past 0.5 to 0.78 Ma
these estimates lend support to fault-creep tectonic models
such as McCaffrey, 2005; Bos and Spakman, 2005

For the C2 directions, two options are possible:

1: 100% tilt-corrected directions indicate 30-40°CW rotation of Diablo rocks after ~3Ma, followed by 15-20°CCW rotation of basin after ~1.0 Ma (post-Hueso time)

2: optimal tilt-correction results in 19°+/- 12°CW rotation of basin after ~3.5 Ma, and little or no rotation since that time.

Overall Conclusions:

Borrego Badlands/Oil Well Wash
modest rotations (0-8°CW, 0-7°/Ma rate)
base of Ocotillo/Brawley regional dis/unconformity at ~1.0 Ma

FCVB/Split Mtn:
new magnetostratigraphy and section calls for major revision of Johnson et al., 1983 model for both basin subsidence and rotations

important changes in subsidence and rotation at 4.5 and 3.2 Ma