Simple rotations

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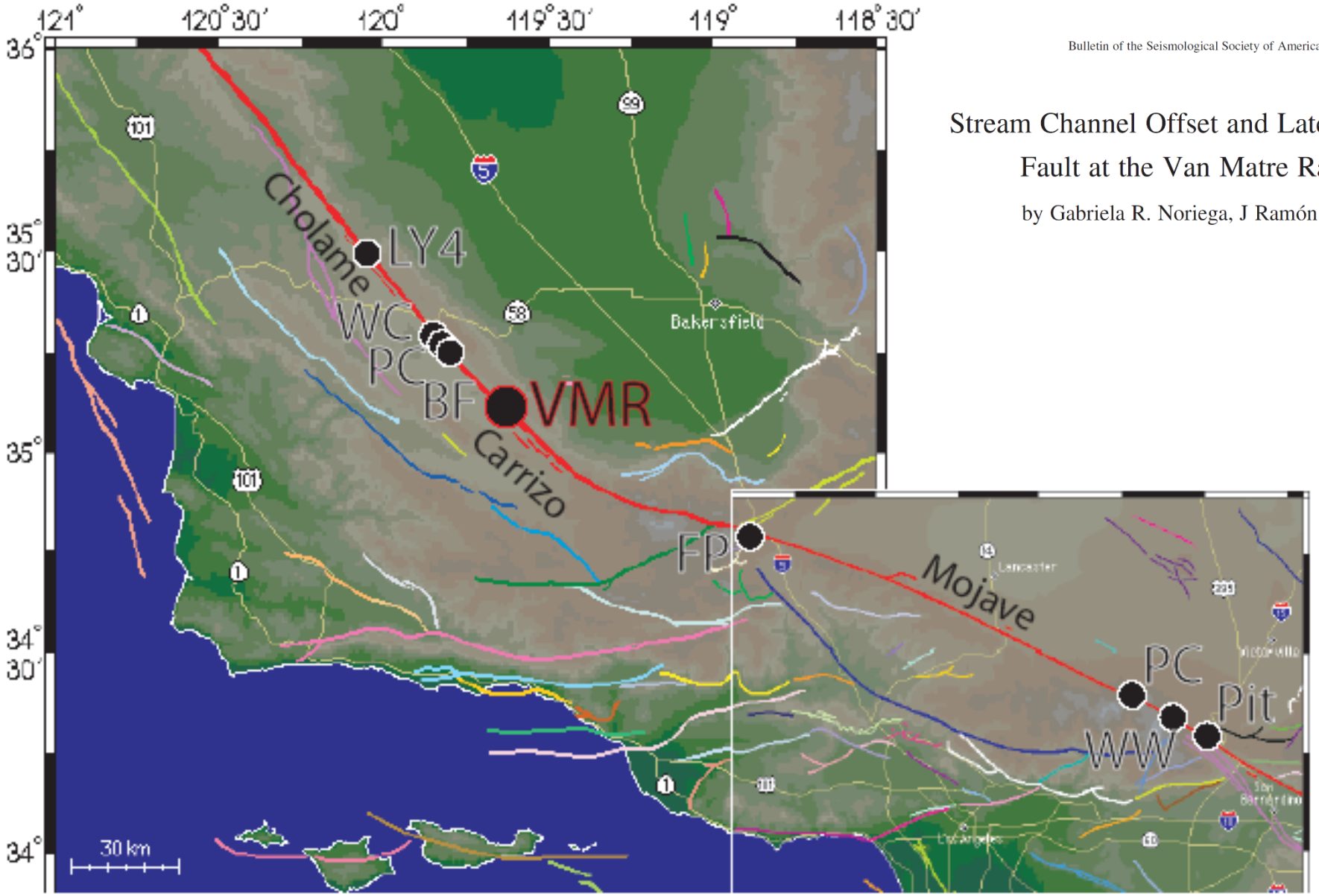
Example: Van Matre Ranch paleoseismic Site



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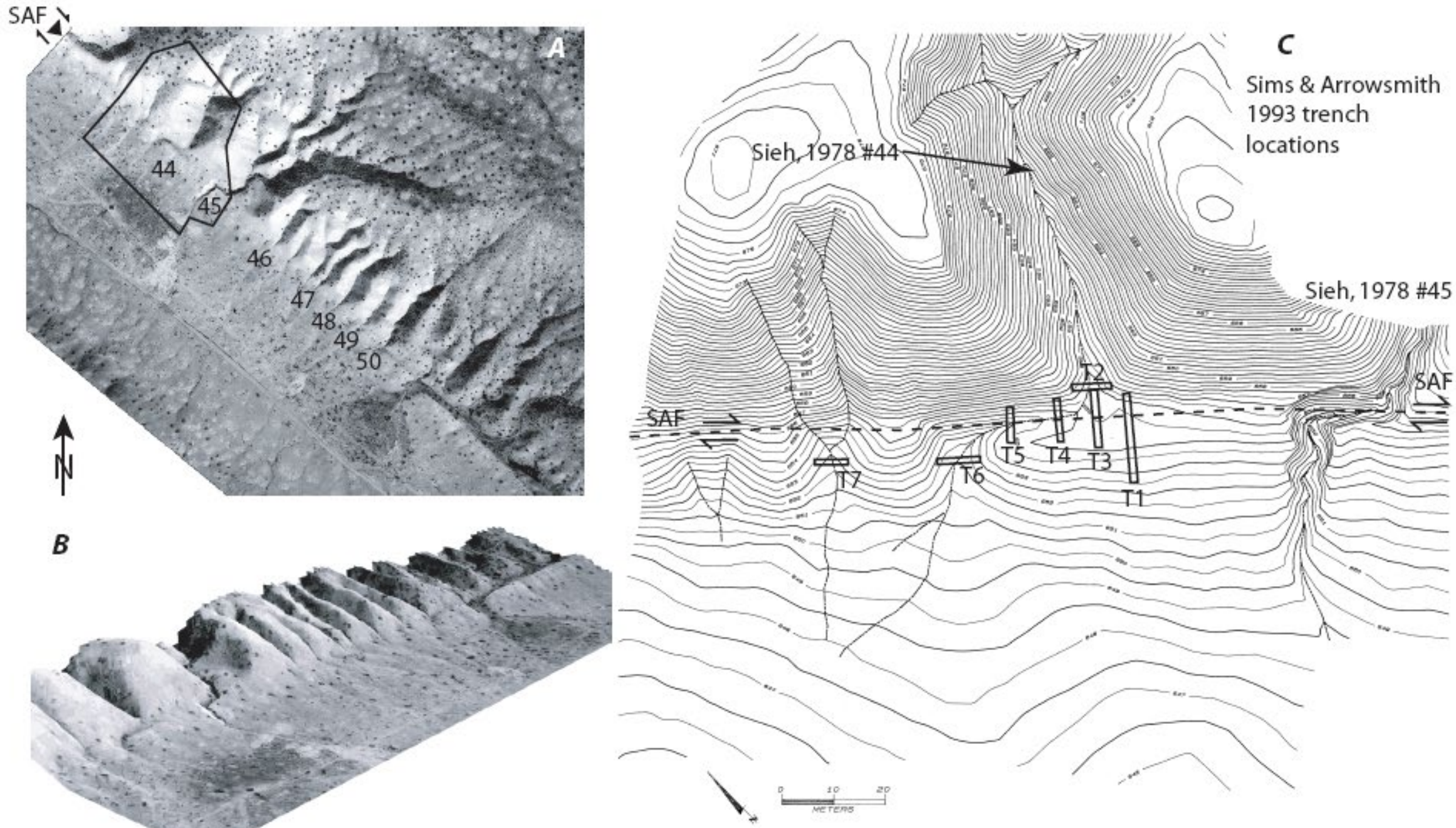
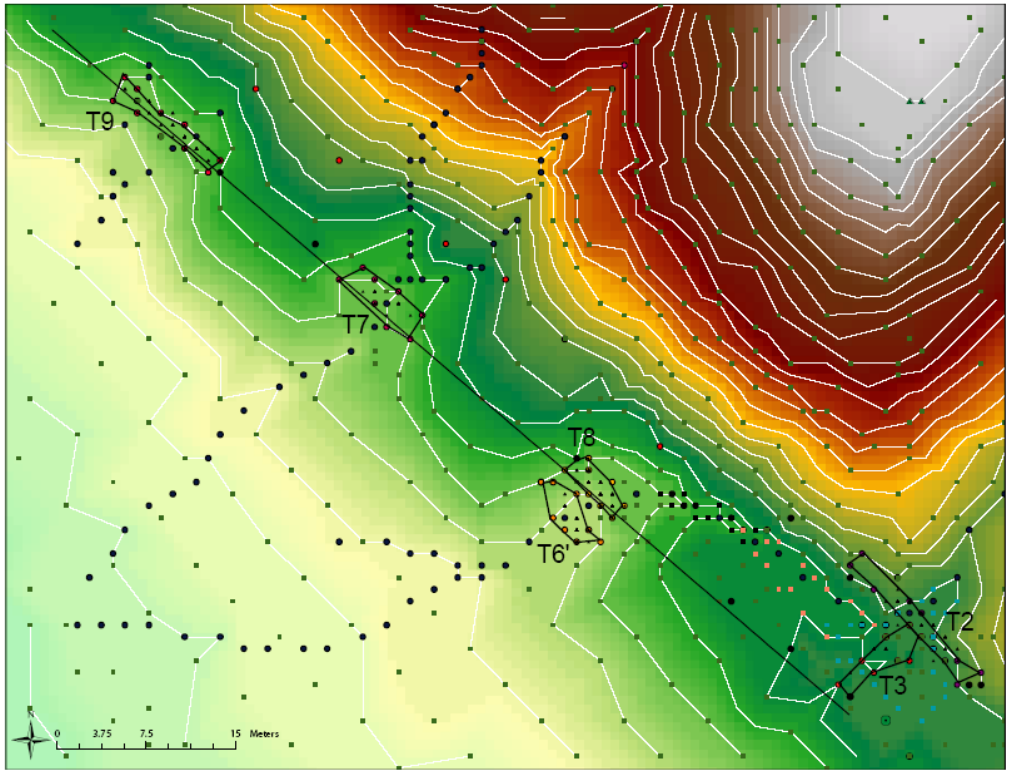
Stream Channel Offset and Late Holocene Slip Rate of the San Andreas Fault at the Van Matre Ranch Site, Carrizo Plain, California

by Gabriela R. Noriega, J Ramón Arrowsmith, Lisa B. Grant, and Jeri J. Young


SAF
A
44
45
46
47
48
49
50
N
B
C
Sims & Arrowsmith
1993 trench
locations
Sieh, 1978 #44
Sieh, 1978 #45
SAF
SAF
T2
T5
T4
T3
T7
T6
T1
0
10
20
METERS

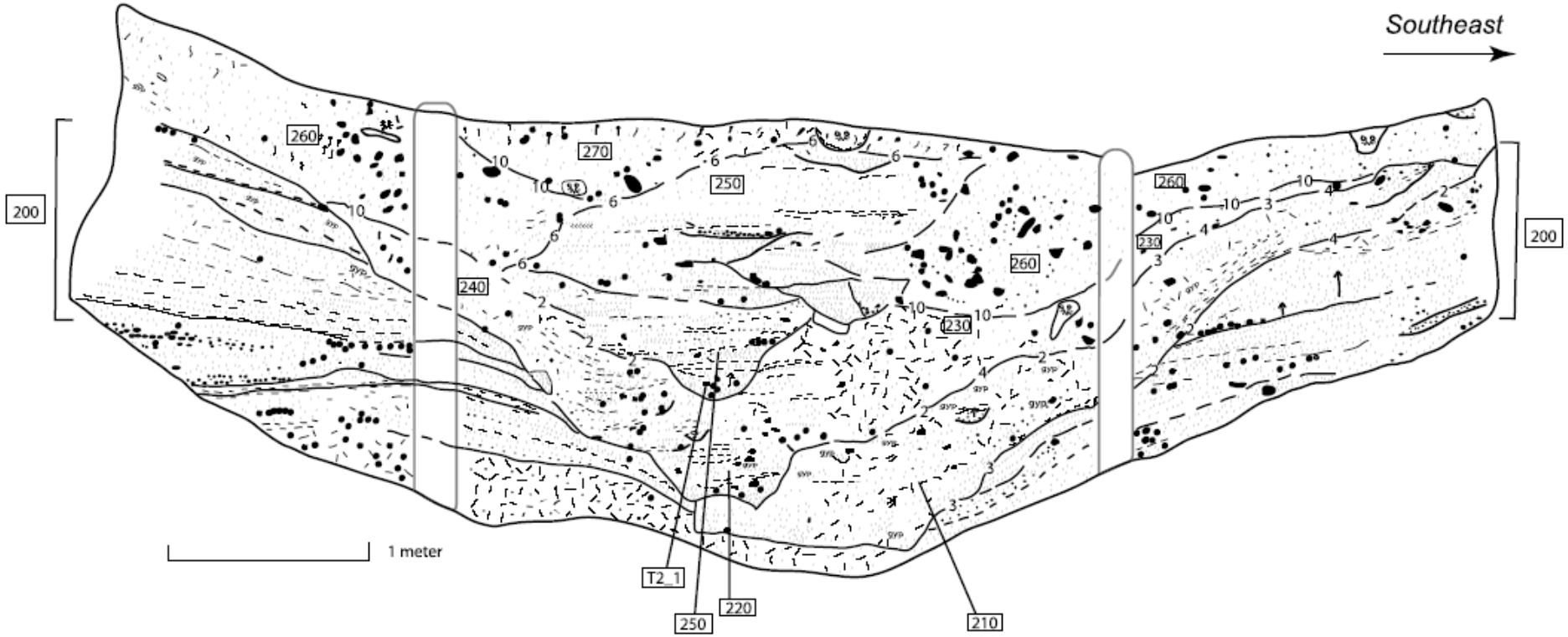
2004 Measurements						UTM/GPS		
	E	N	H			E	N	H
0	1000	1000	100	Base (1993 point 2)		254069	3893433	645
3	1097.861	1001.704	128.1	shot to station 3		254139	3893503	667
70	1051.88	1038.702	105.6	T9_control		254080	3893496	640
71	1053.164	1028.231	106.5	T7_control		254088	3893491	650
72	1053.449	1000.974	105.1	T6_prime_control		254108	3893472	652
73	1056.372	1000.414	105.3	T8_control		254109	3893473	651
74	1067.253	963.185	108.3	T2_control		254143	3893455	653
75	1058.533	969.826	107.3	T3_control		254133	3893453	652

How do we get the local coords into the global one?
And how to project to the fault parallel




A
SAF
B
SAF


B
SAF



Explanation

Logging symbols

- sharp contact
- approximately located contact
- 8 gradational contact in cm
- ? ? location of contact is questionable
- T2_1 ^{14}C sample location
- 210 Unit label

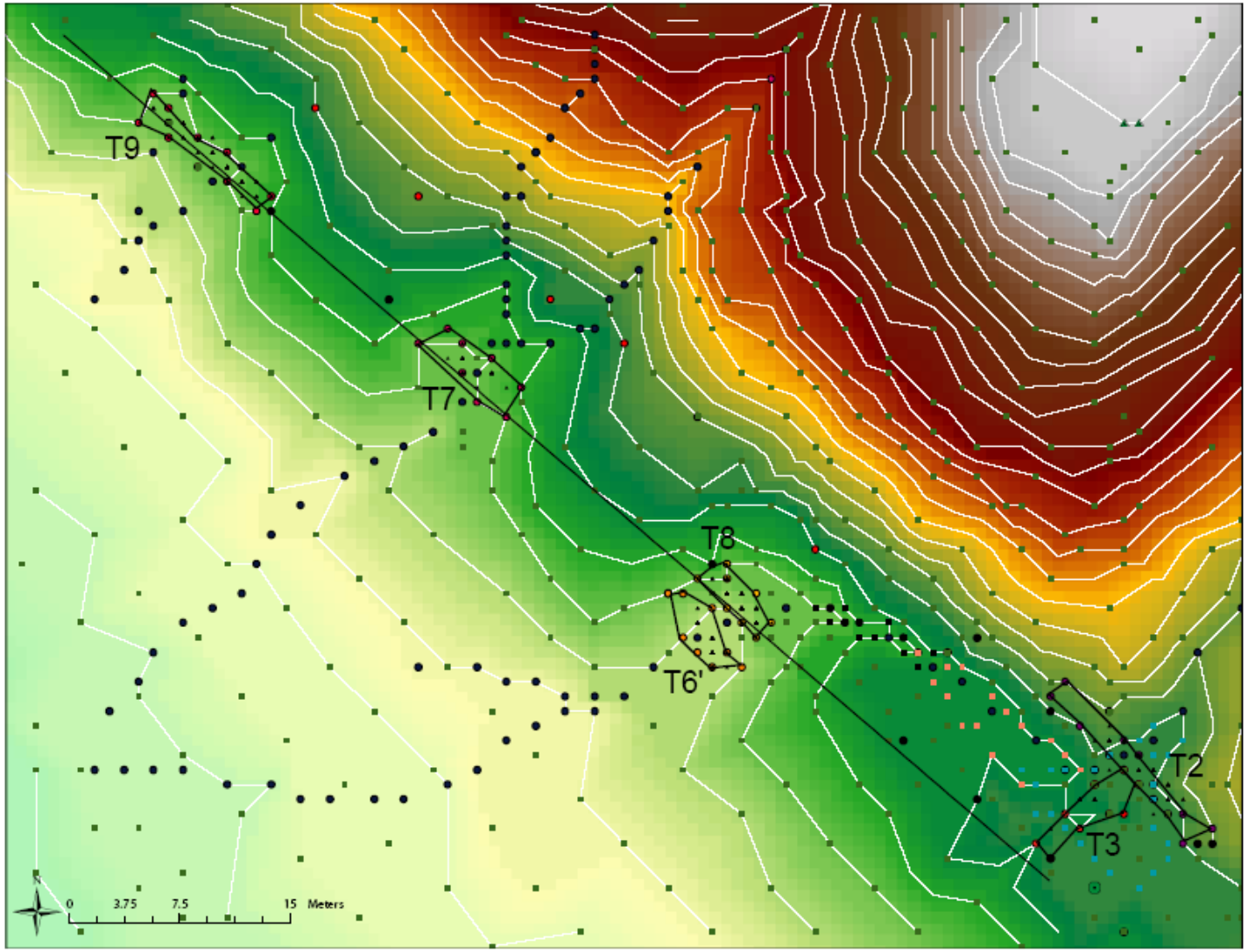
Lithologic Symbols

- burrows
- k carbonate
- gyp gypsum
- fining upward
- carbon sample
- laminated silt

- fine-medium sand
- coarse sand
- cobbles and pebbles
- clay
- colluvium
- cobble or boulder to scale
- granitic boulder to scale

“Projection”

Rotate coordinates to Parallel and perpendicular to the fault trace



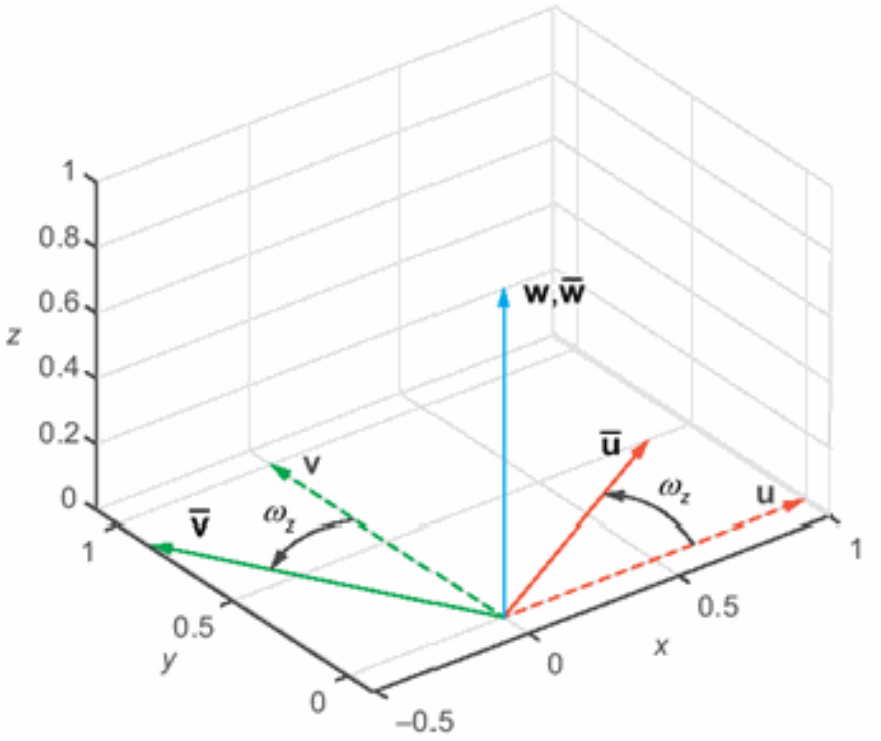


Figure 2.42 Pure rotation of material lines about the z-axis through angle ω_z as tracked by vectors **u**, **v**, and **w**, originally coincident with the coordinate axes. After rotation the new vectors are $\bar{\mathbf{u}}$, $\bar{\mathbf{v}}$, and $\bar{\mathbf{w}}$. The sense of rotation follows a right-hand rule: it is in the direction of the fingers of your right hand with your thumb pointing in the direction of the positive z-axis.

Row times column multiplication

example, the following matrix provides a pure rotation about the z-axis through an angle ω_z for material lines lying in the (x, y)-plane:

$$[\mathrm{R}] = \begin{bmatrix} \cos\omega_z & -\sin\omega_z & 0 \\ \sin\omega_z & \cos\omega_z & 0 \\ 0 & 0 & 1 \end{bmatrix} \tag{2.63}$$

To visualize this rotation consider three unit vectors that overlie material lines extending from the origin along the coordinate axes before rotation (Figure 2.42):

$$[\mathrm{u}] = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}, \quad [\mathrm{v}] = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}, \quad [\mathrm{w}] = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

These are unit vectors and they are orthogonal. Using [R] from (2.63) as the pre-multiplier for each vector, we find the rotated vectors:

$$[\bar{\mathrm{u}}] = \begin{bmatrix} \cos\omega_z \\ \sin\omega_z \\ 0 \end{bmatrix}, [\bar{\mathrm{v}}] = \begin{bmatrix} -\sin\omega_z \\ \cos\omega_z \\ 0 \end{bmatrix}, [\bar{\mathrm{w}}] = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \tag{2.64}$$

```
%rotation demonstration
%VMR example

%data:E N   H
coords=[
254069  3893433 645
254139  3893503 667
254080  3893496 640
254088  3893491 650
254108  3893472 652
254109  3893473 651
254143  3893455 653
254133  3893453 652
254065  3893509 999
254134  3893450 999];%last two are the SAF trace

x=coords(:,1);
y=coords(:,2);

x_mean=mean(x);
y_mean=mean(y);

figure(1)
clf
plot(x_mean,y_mean,'bo')
hold on
plot(x,y,'k.', 'MarkerSize',15)
plot([x(9) x(10)],[y(9) y(10)],'k-', 'MarkerSize',15)
xlabel('Easting (m)')
ylabel('Northing (m)')
axis equal

coords(:,1)=coords(:,1)-x_mean;
coords(:,2)=coords(:,2)-y_mean;

omegaz = 50; %rotation angle in degrees

R = [cosd(omegaz) -sind(omegaz) 0;
    sind(omegaz) cosd(omegaz) 0;
    0   0 1];

coords_prime = coords*R;
x_prime=coords_prime(:,1)+x_mean;
y_prime=coords_prime(:,2)+y_mean;

plot(x_prime,y_prime,'r.', 'MarkerSize',15)
plot([x_prime(9) x_prime(10)],[y_prime(9) y_prime(10)],'r-')
```