

MECCANISMO FOCAL

Per determinarlo univocamente sono necessari tre parametri:

due per il piano della faglia
uno per la direzione del moto relativo

I parametri che si usano per determinare il piano di faglia sono:

- θ direzione (strike) dell'intersezione della superficie della faglia con il piano orizzontale [in gradi]
- δ angolo di immersione (dip) della faglia: l'angolo tra l'inclinazione della faglia ed il piano orizzontale [in gradi]
NB. Certi autori danno l'angolo di inclinazione che è $90^\circ - \delta$!
- ϕ direzione di immersione (azimuth of dip): angolo nel piano orizzontale tra il nord e la direzione di immersione (è perpendicolare alla direzione di strike!)

Vengono di solito usate due combinazioni:

1) direzione di strike + angolo di immersione

2) direzione di immersione + angolo di immersione

la convenzione sulla direzione di strike
(essendo due gli angoli possibili!) può
essere diversa:

- quella più vicina al nord
- azimuth del piano misurato in
senso orario da nord (Kasahara, 1981)
- direzione per cui il piano di faglia
immerge a destra se si guarda lungo
la direzione di strike (il tetto è a destra)
(Herrmann, 1975; Aki & Richards, 1980)

Per parametrizzare la direzione del moto relativo
viene usato

λ direzione del vettore di scorrimento (rake)
cioè l'angolo nel piano di faglia tra la
direzione di strike ed il vettore di scorrimento

Si usano due possibili convenzioni:

1) $-180^\circ < \lambda \leq 180^\circ$ (Aki & Richards, 1980)

2) $0^\circ \leq \lambda < 360^\circ$ (Panza et al., 1973)

Faglia inversa: 1) $0^\circ < \lambda < 180^\circ$

2) $0^\circ < \lambda < 180^\circ$

Faglia normale: 1) $-180^\circ < \lambda < 0^\circ$

2) $180^\circ < \lambda < 360^\circ$

Faglia trascorrente:

$$\begin{aligned}\lambda &= 0^\circ \\ \lambda &= 180^\circ\end{aligned}$$

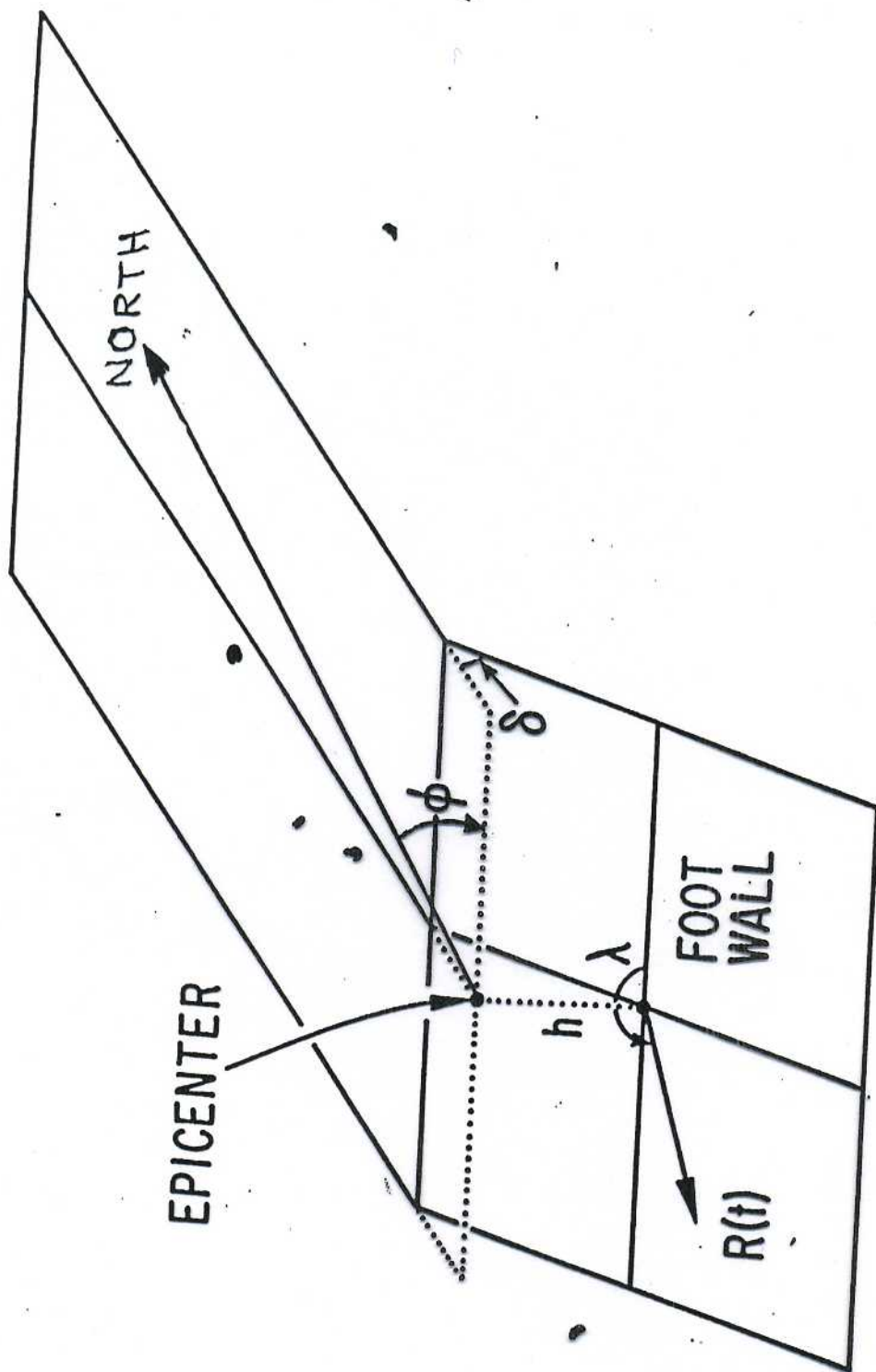
sinistrorsa
destrosa

La proiezione della normale di un piano viene detta polo del piano.

Ogni polo viene parametrizzato da due quantità:

- direzione (trend) cioè l'angolo tra la direzione della normale nel piano orizzontale ed il nord.
- inclinazione (plunge), angolo tra il piano orizzontale e la direzione della normale

La stessa parametrizzazione vale per gli assi di compressione, tensione e shear nullo.



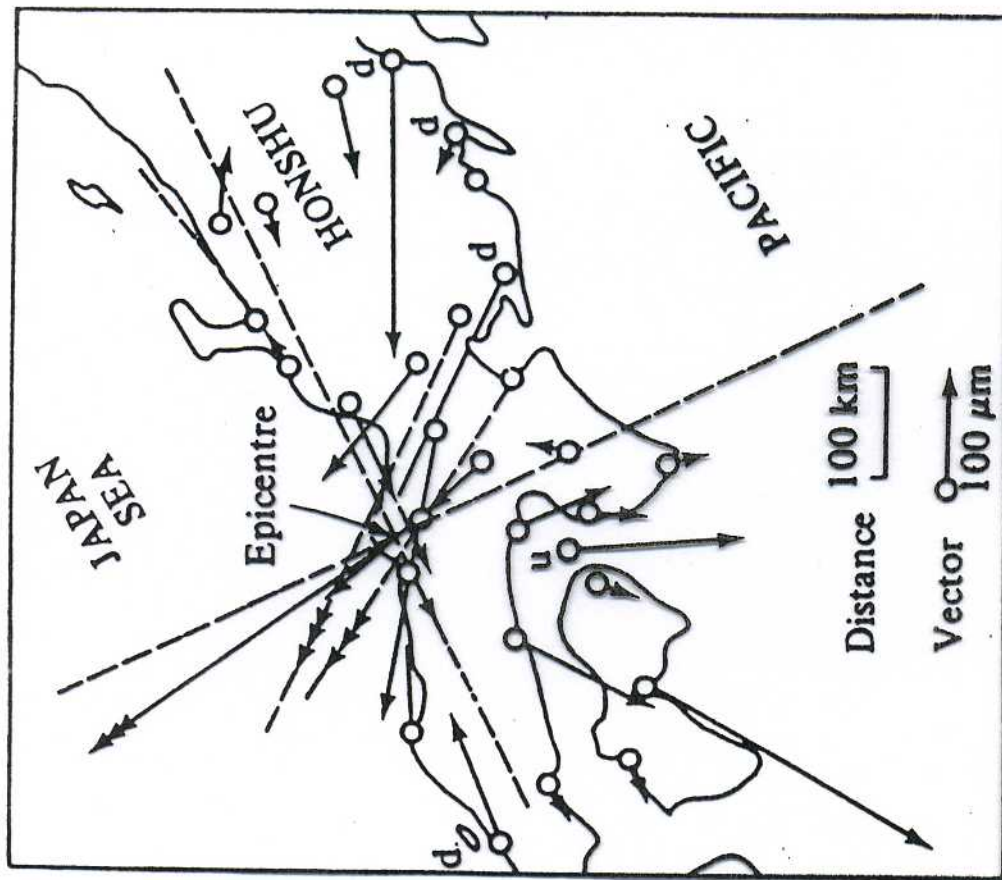
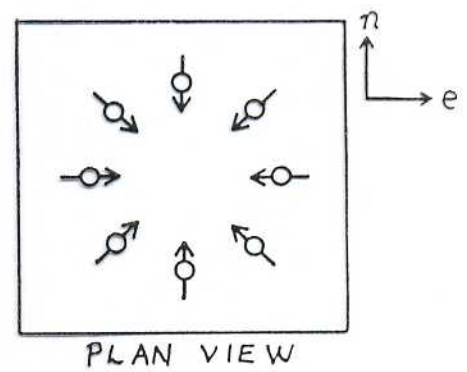
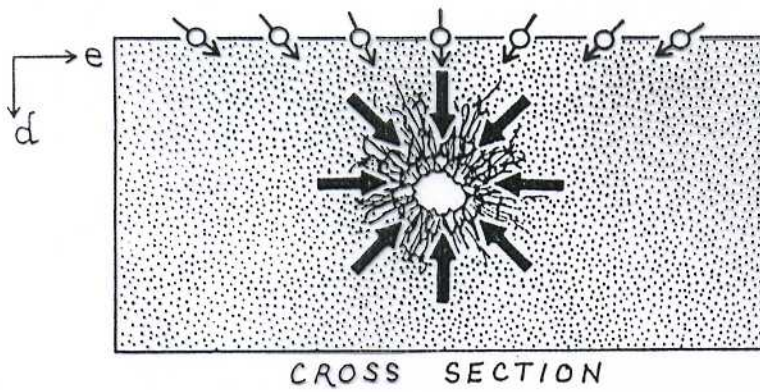
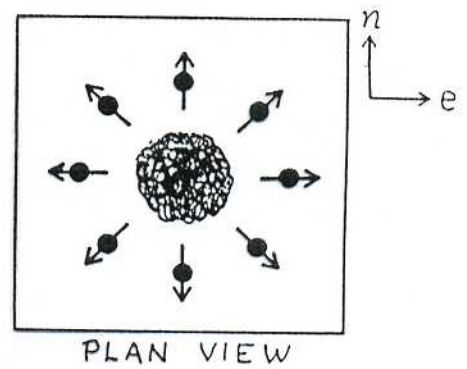
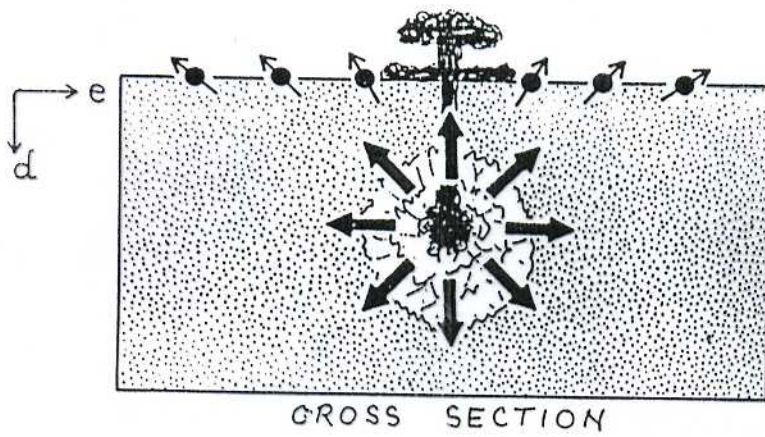
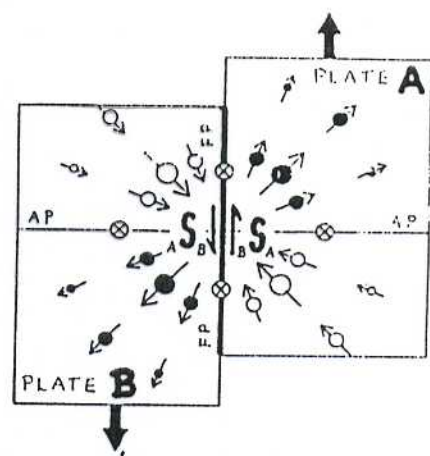
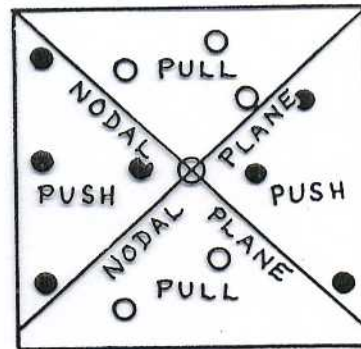
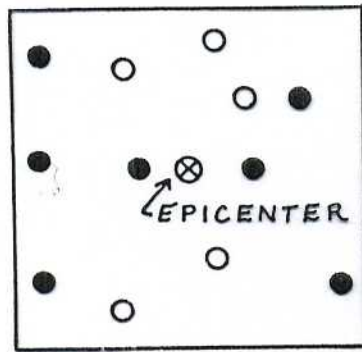
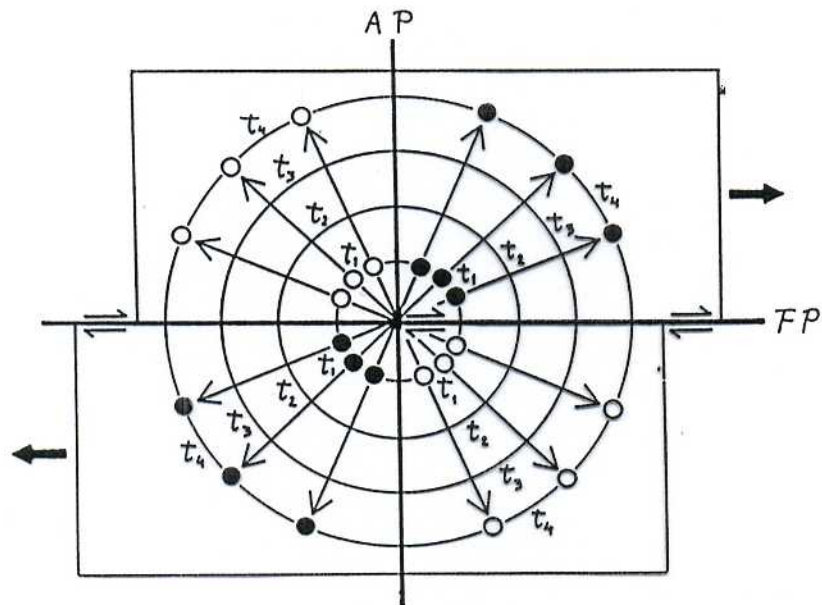


Fig. 3.1. Ground movements in the initial P-phase for the Tango earthquake, Honshu, Japan (1927, $M=7.5$). Symbols u and d denote the upward and downward initial P-pulses respectively. (After Honda, 1957.)

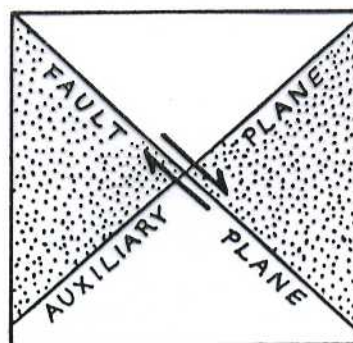


→ DIRECTION OF FIRST MOTION
 ● FIRST MOTION IS PUSH (COMPRESSION)
 ○ FIRST MOTION IS PULL (DILATATION)
 ⊗ NO FIRST MOTION (UNDEFINED)
S / SLIP VECTOR SHOWING MOTION
 A_B / OF PLATE B RELATIVE TO PLATE A

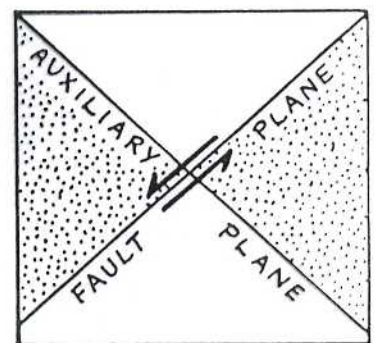




 ZONE OF COMPRESSION
 ZONE OF DILATATION

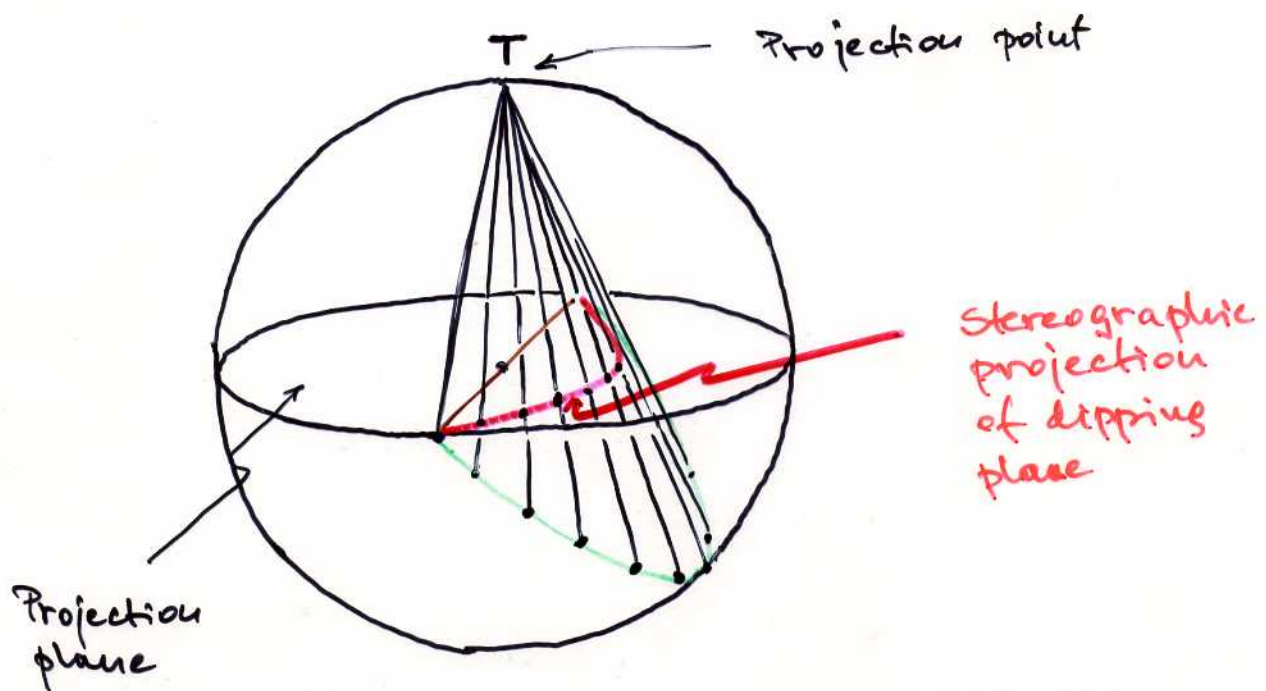
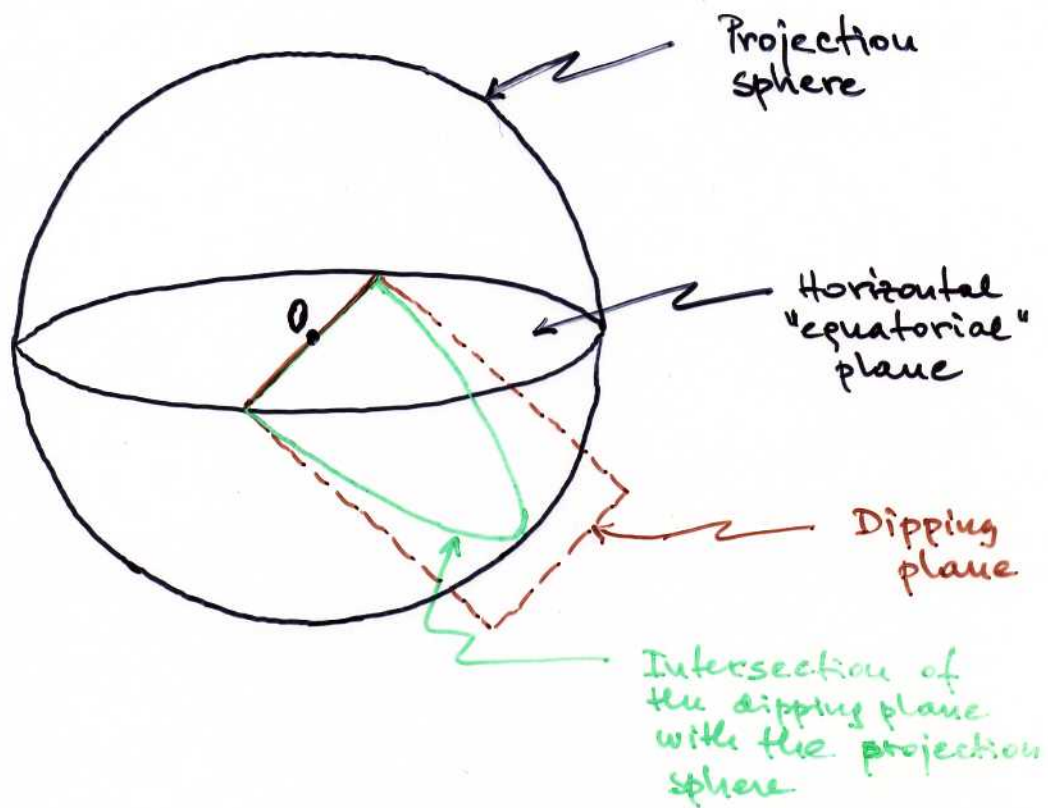


RIGHT LATERAL

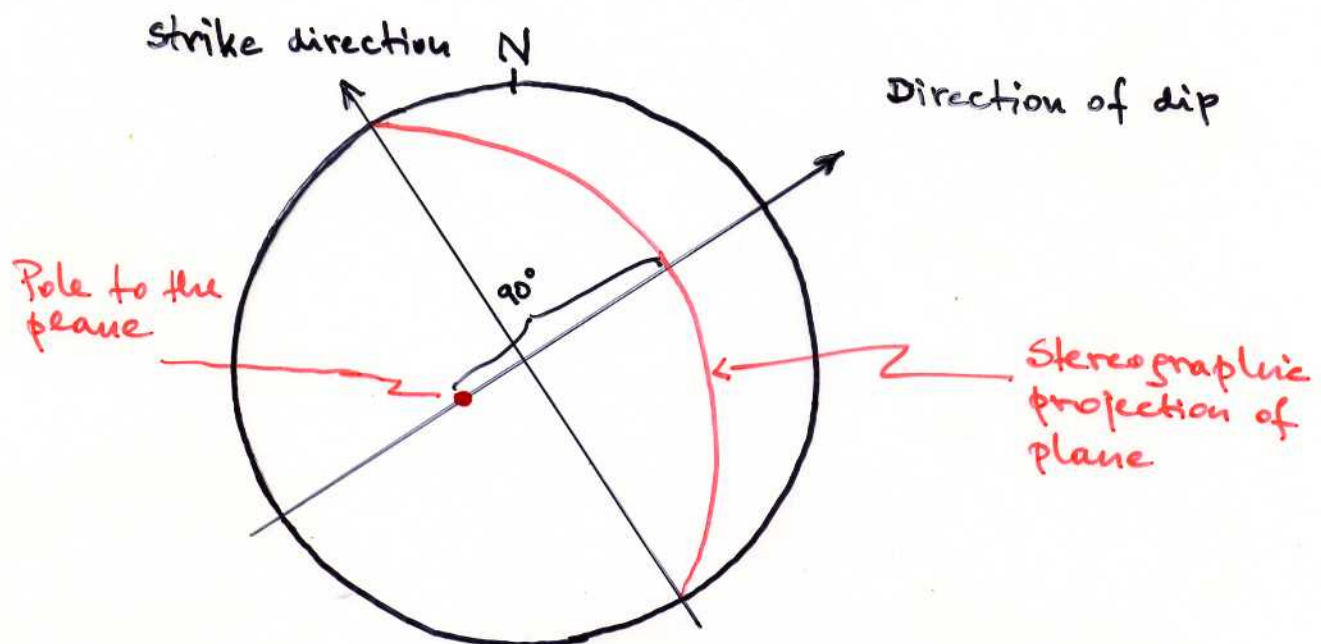
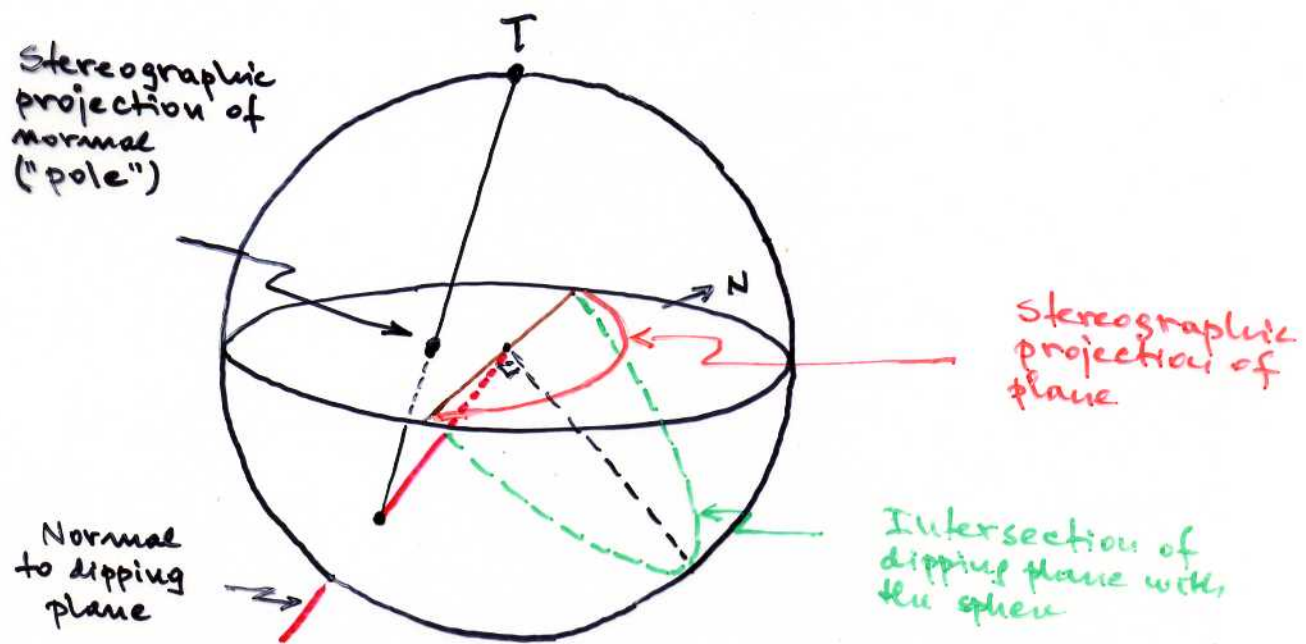


LEFT LATERAL

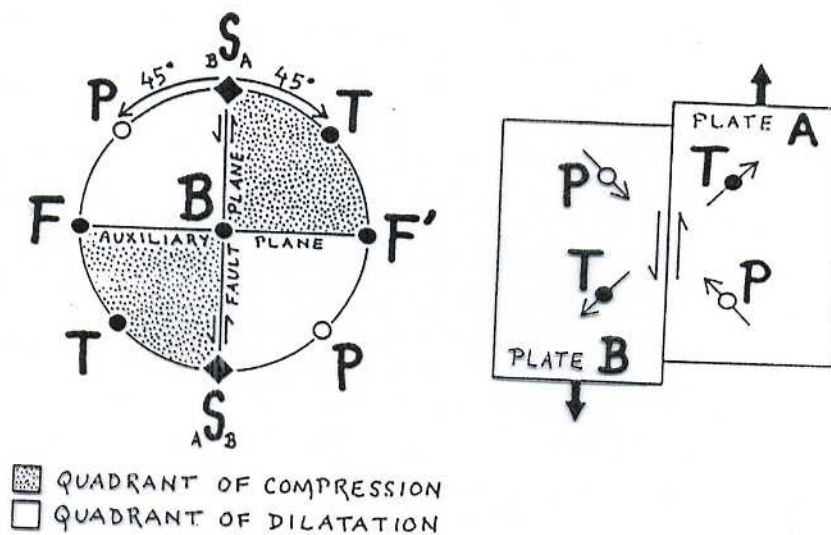
STEREOGRAPHIC PROJECTION OF PLANES



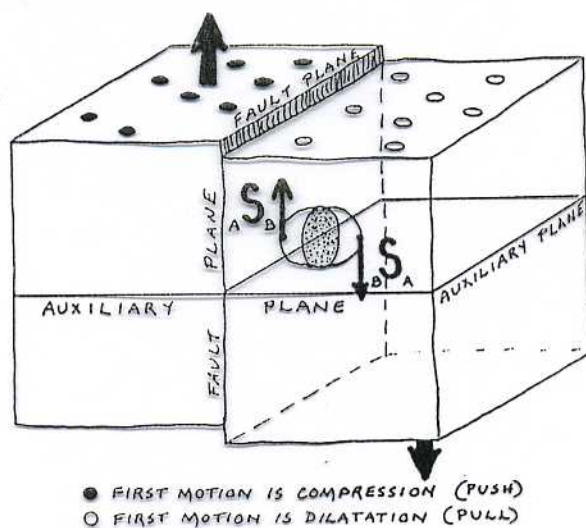
STEREOGRAPHIC PROJECTION OF NORMAL



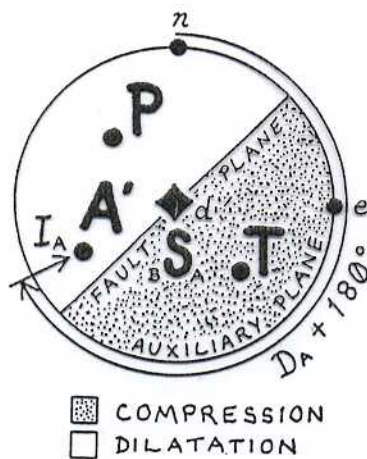
Plane view of equatorial plane

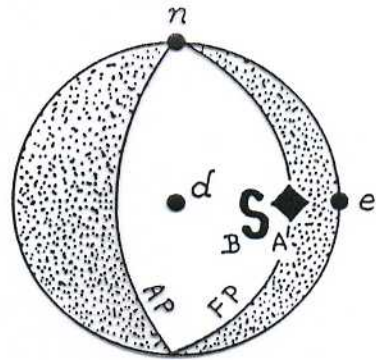
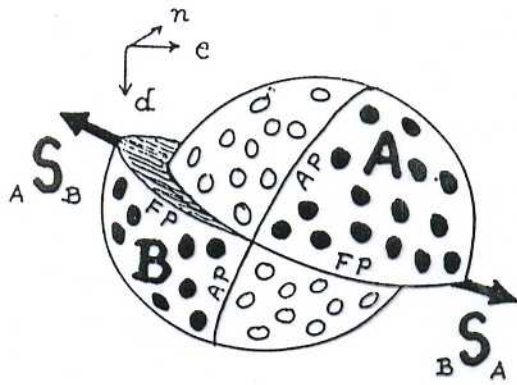
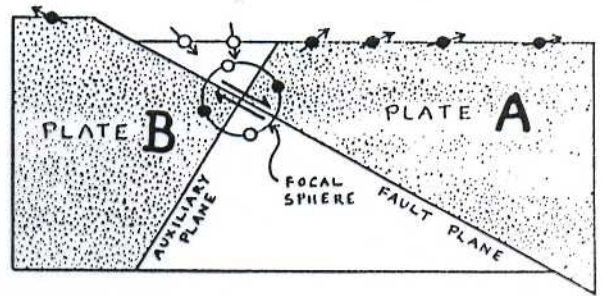
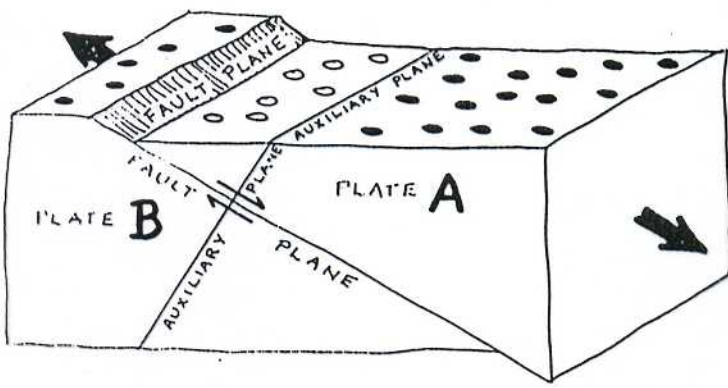


Box 6-5. Focal Sphere for a Vertical Normal Fault.

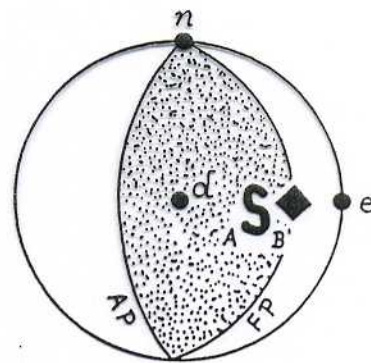
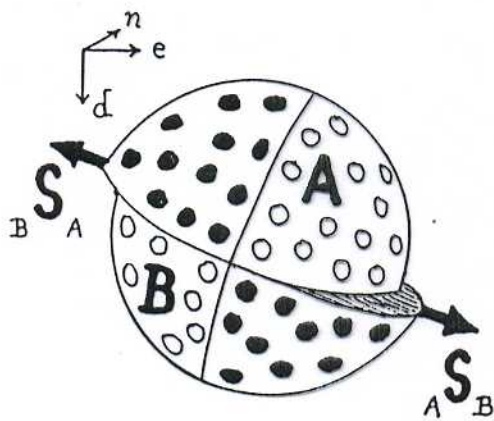


Box 6-6. Plotting First Motions for a Normal Fault on a Projection.

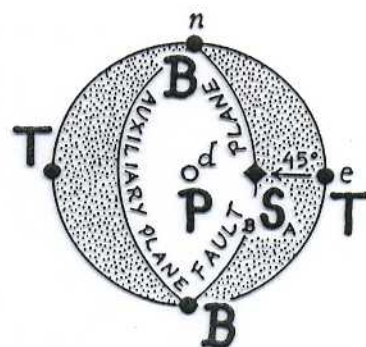
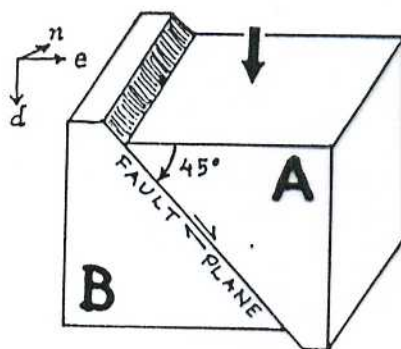




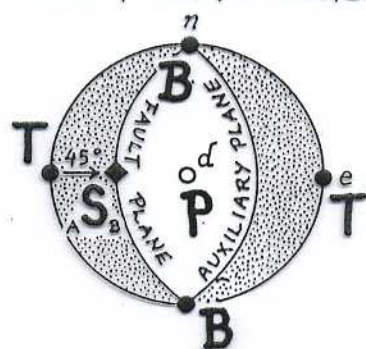
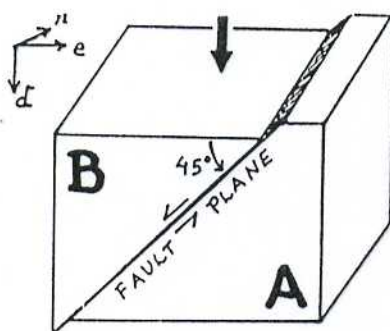
NORMAL FAULT



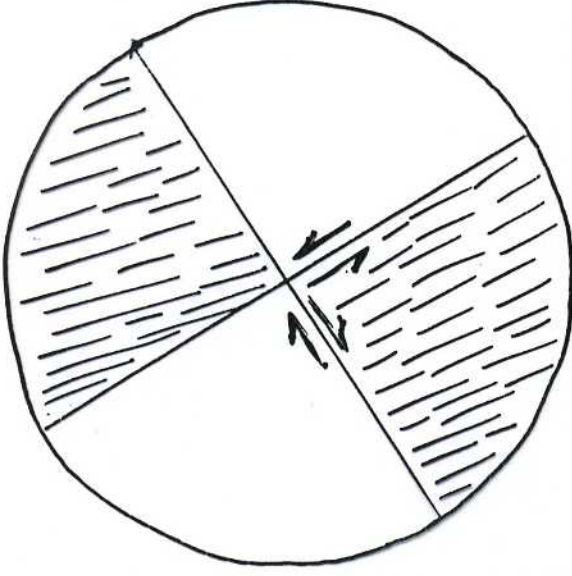
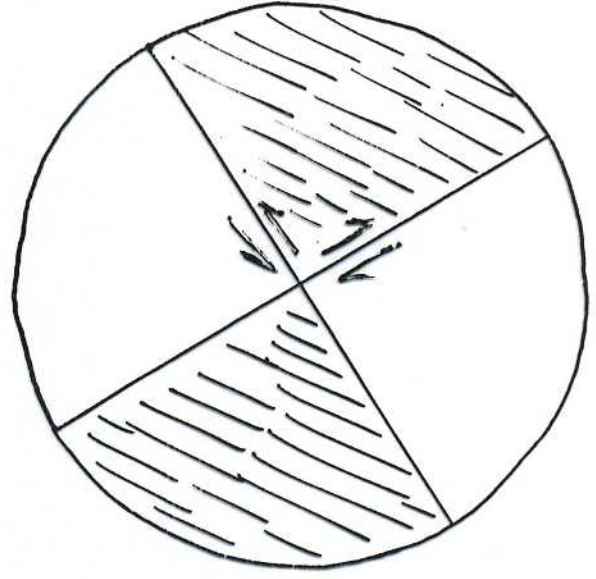
THRUST FAULT



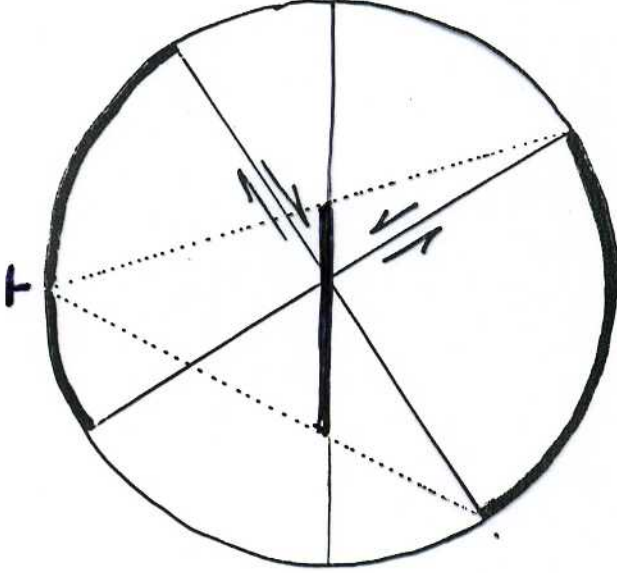
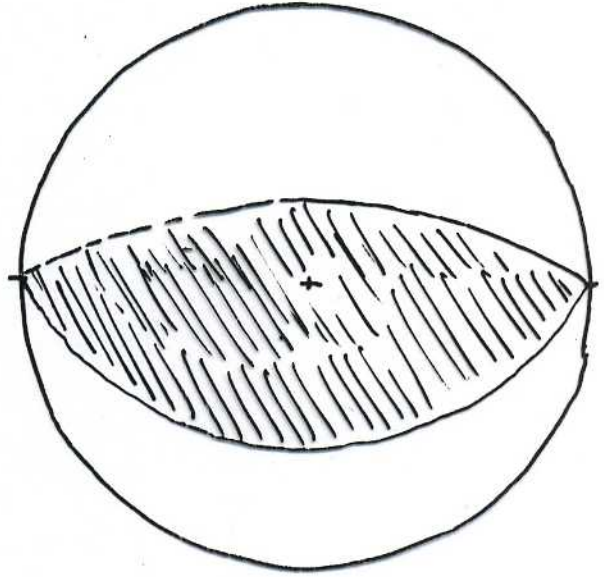
LOWER HEMISPHERES



STRIKE-SLIP FAULT



THRUST FAULT



NORMAL FAULT

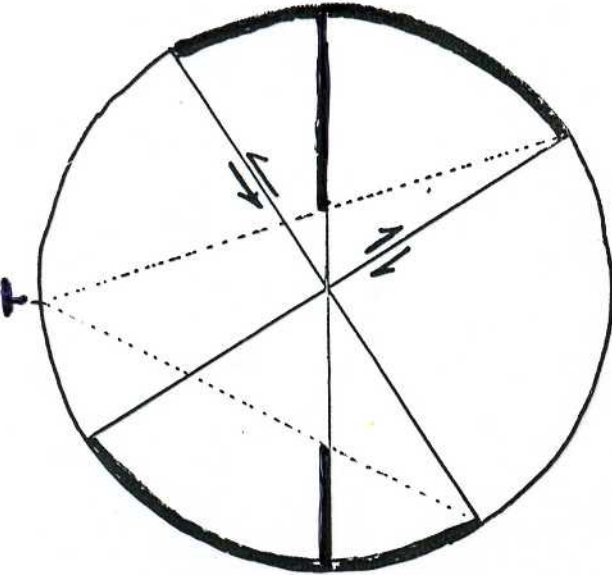
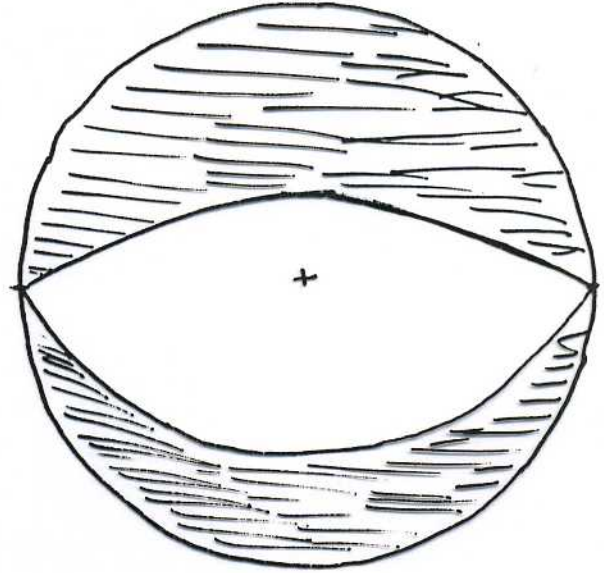
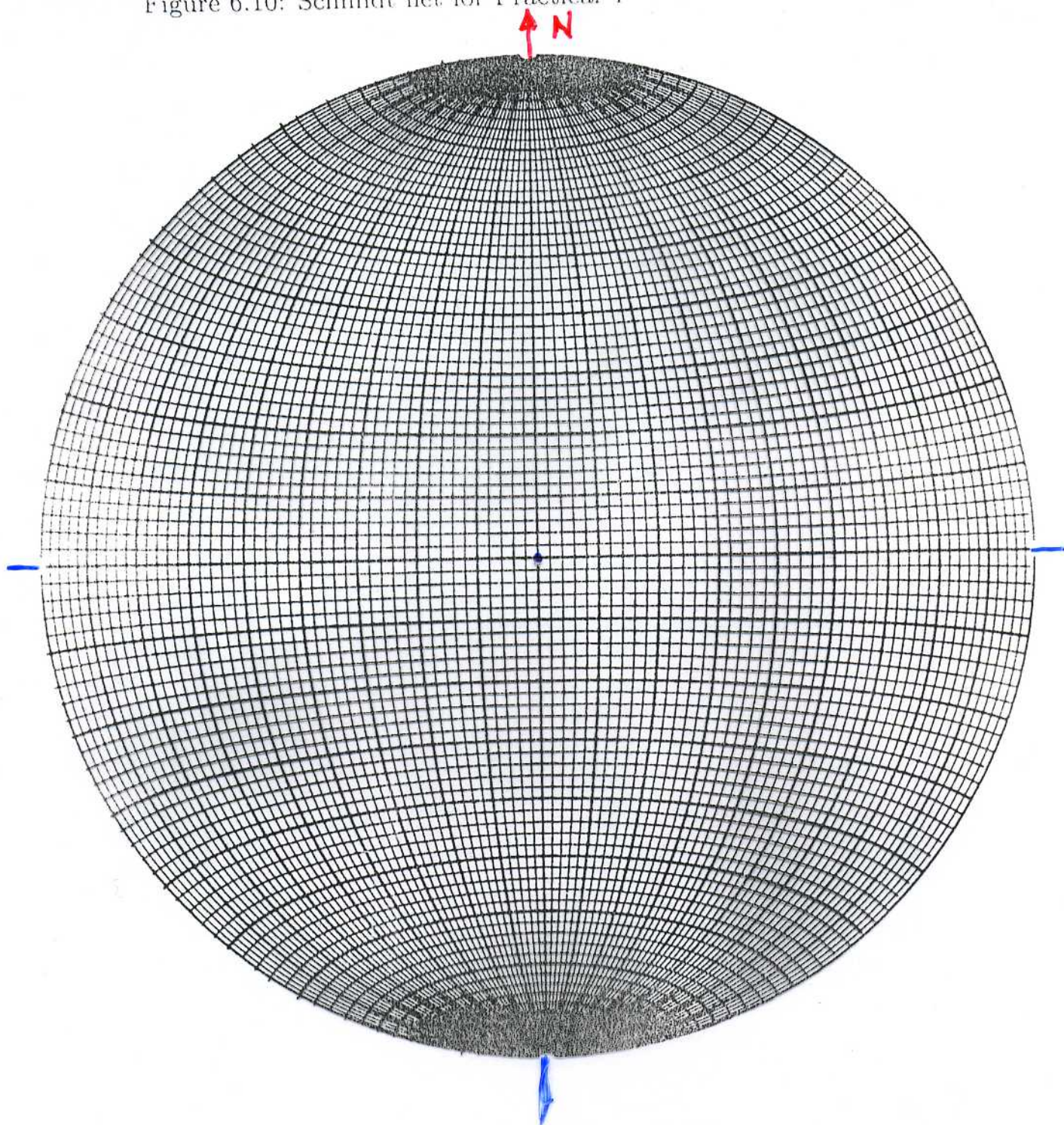
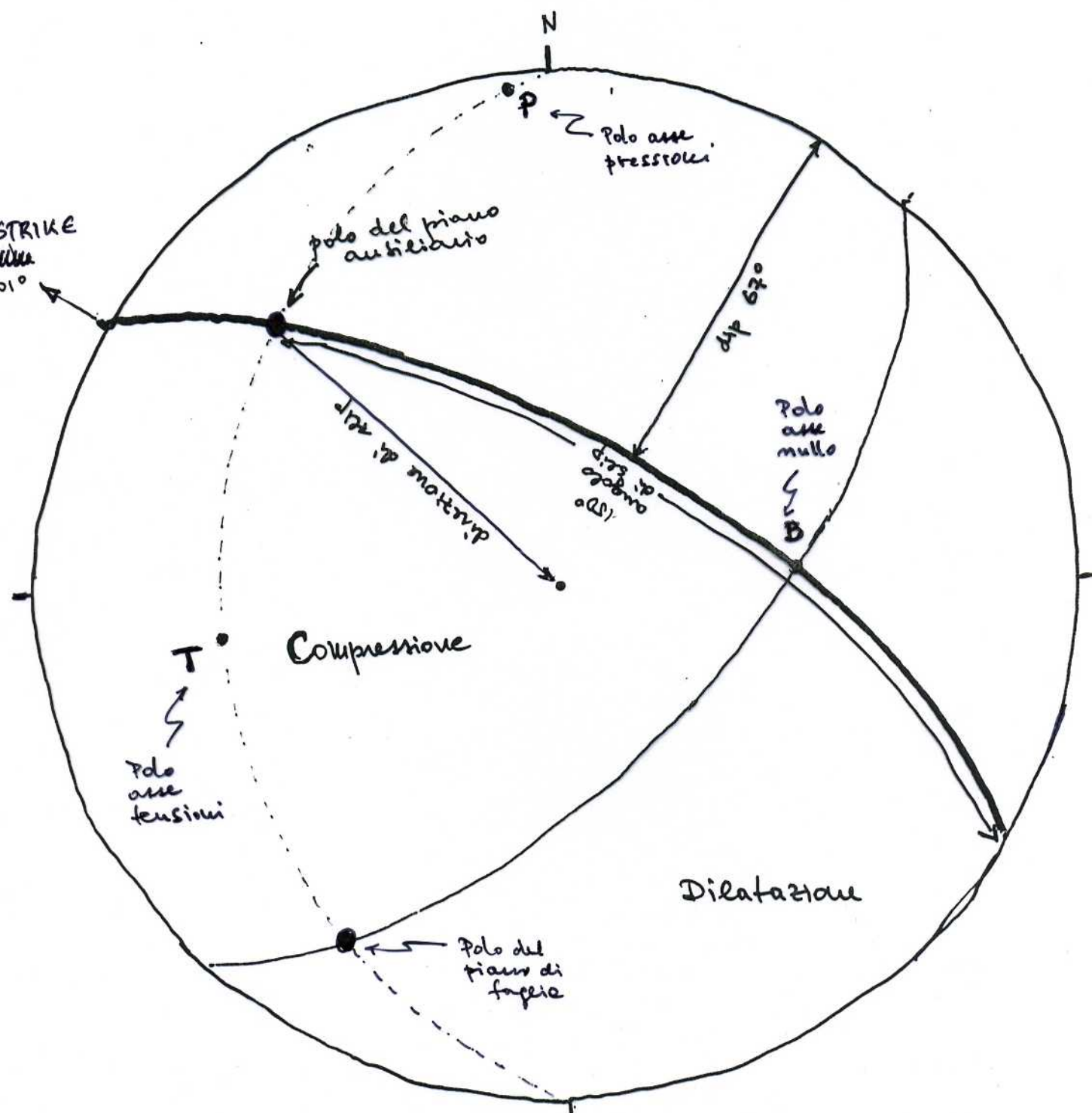


Figure 6.10 Schmidt net for Problem 7



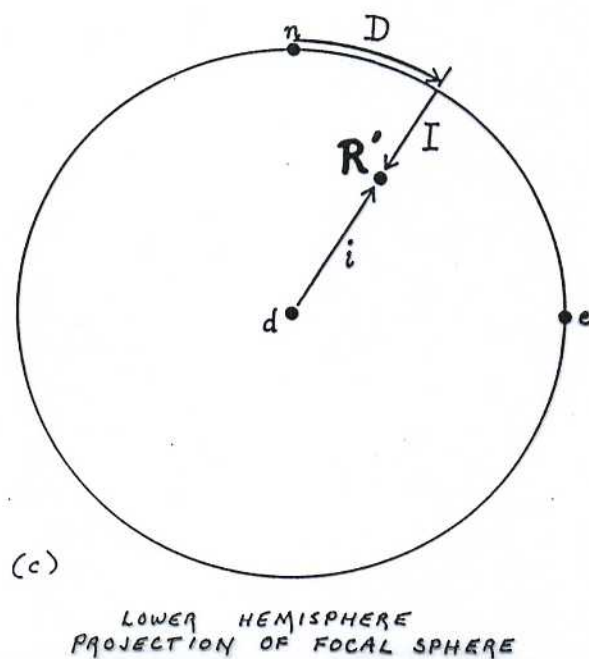
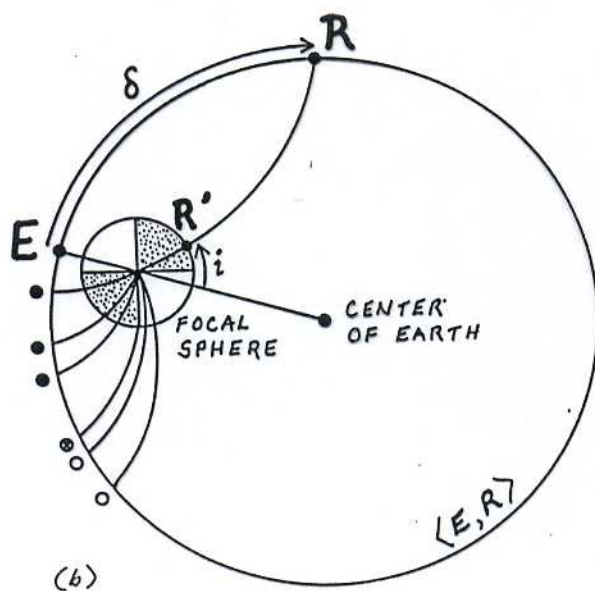
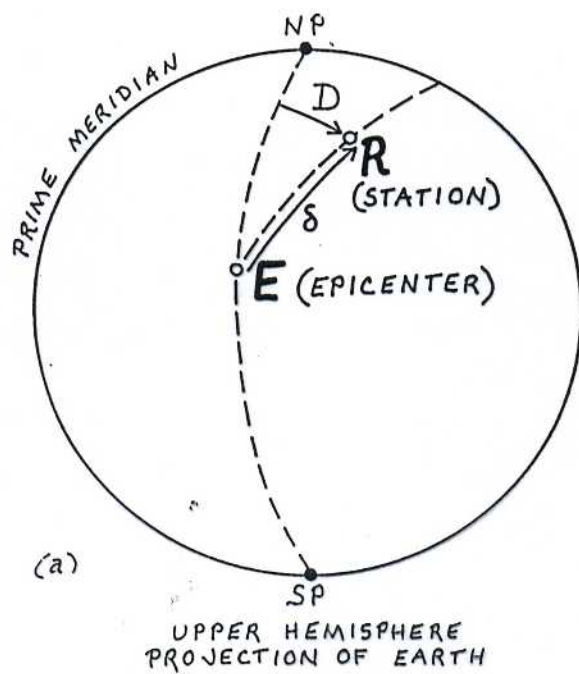


————— piano di faglia
 ————— piano ausiliario

$$\theta = 301^\circ$$

$$\delta = 67^\circ$$

$$\lambda = 150^\circ$$



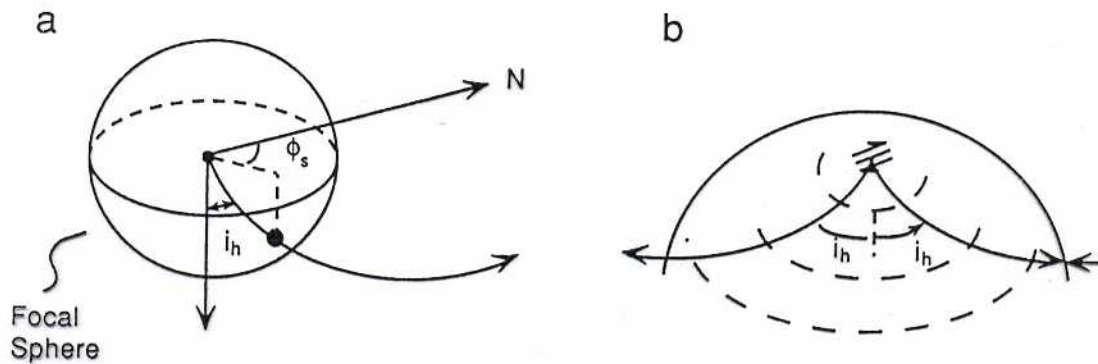
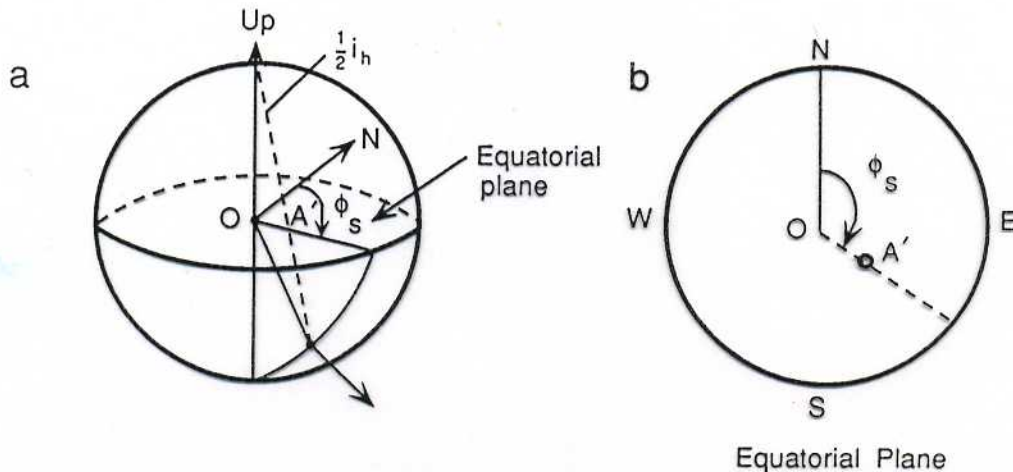


FIGURE 8.23 (a) The small focal sphere near the source, which can be thought of as the initial outgoing P (or S) wavefront. The raypath to a point on the Earth's surface (b) will have an associated takeoff angle and azimuth.



Stereographic $OA' = \tan(\frac{1}{2} i_h)$

Equal area $OA' = \sqrt{2} \sin(\frac{1}{2} i_h)$

FIGURE 8.24 Projections for mapping spherical surfaces onto a plane. Both stereographic and equal-area projections are used, with the difference being the radial point A' used to represent the chord from the top of the focal sphere to the point intersected by the outgoing raypath. A ray going straight down intersects the center of the equatorial plane. Azimuth is preserved in the projection.

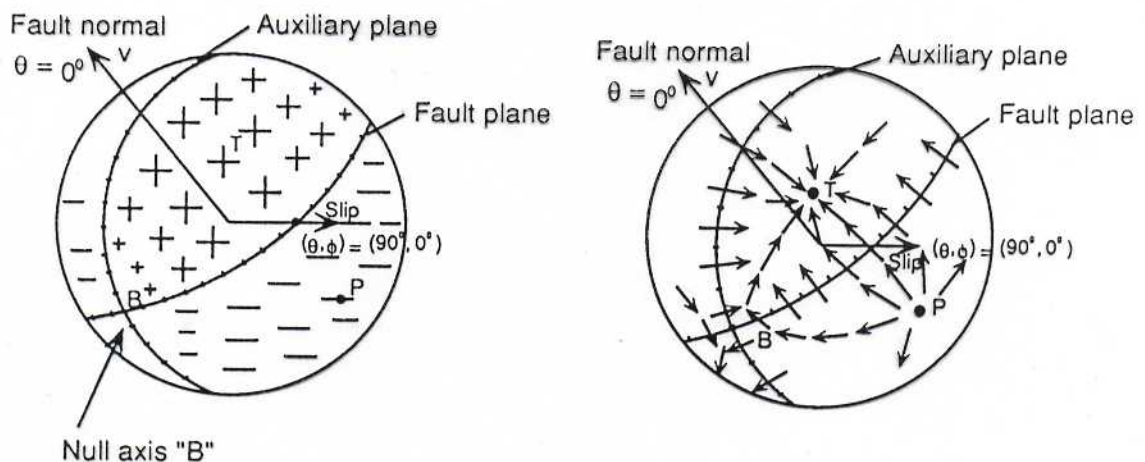


FIGURE 8.27 Focal mechanisms for an oblique-slip event showing P -wave polarities and relative amplitudes (left) and S -wave polarizations and amplitudes (right). Plus signs (+) indicate compressions. The fault and auxiliary planes are shown as well as projections of the P , T , and B axes. (Modified from Aki and Richards, 1980. Copyright ©1980 by W. H. Freeman and Co. Reprinted with permission.)

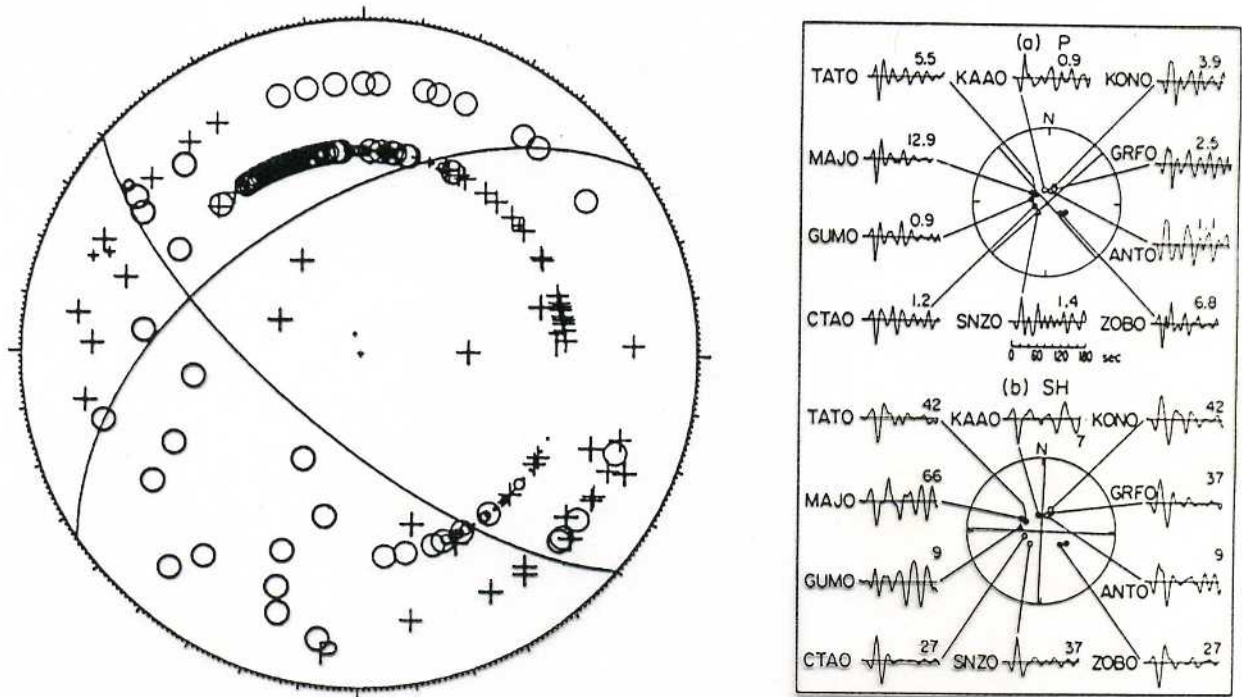
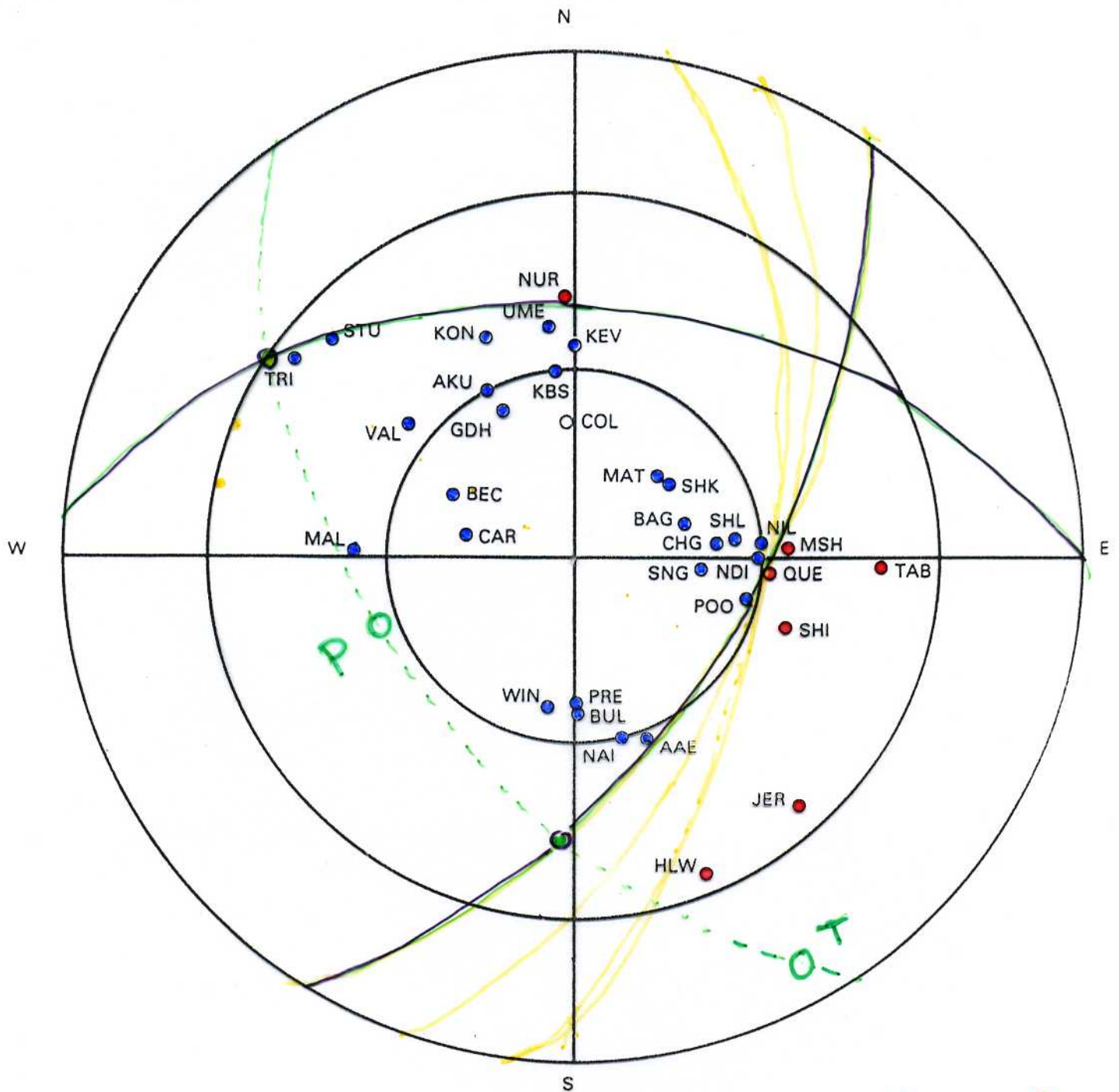


FIGURE 8.28 Examples of well-constrained focal mechanisms. On the left, *P*-wave first motions for the 1989 Loma Prieta earthquake from regional-distance stations are shown in an equal-area lower-hemisphere projection. Compressional motions are indicated by (+) and dilatations by (O). In this case $\phi_f = 130^\circ$, $\delta = 70^\circ$, and $\lambda = 140^\circ$. On the right, teleseismic *P*-wave and *SH*-wave first motions are shown with *P*- and *SH*-radiation nodal planes for the November 8, 1980 Eureka, California earthquake. This left-lateral strike-slip event has $\phi_f = 48^\circ$, $\delta = 90^\circ$, and $\lambda = 0^\circ$. Upward motions of *P* waves correspond to compressions (solid dots), while upward motion of *SH* corresponds to counterclockwise motion at the source. First-arrival amplitudes are shown for an equalized instrument gain. (Left from Oppenheimer, *Geophys. Res. Lett.* **17**, 1199–1202, 1990; © Copyright by the American Geophysical Union. Right from Lay *et al.*, 1982.)

Figure 6.9: Focal sphere for Practical 4

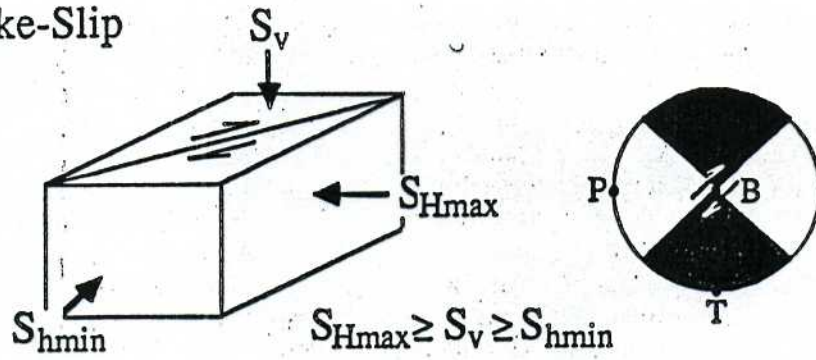


$$\theta = 35^\circ$$

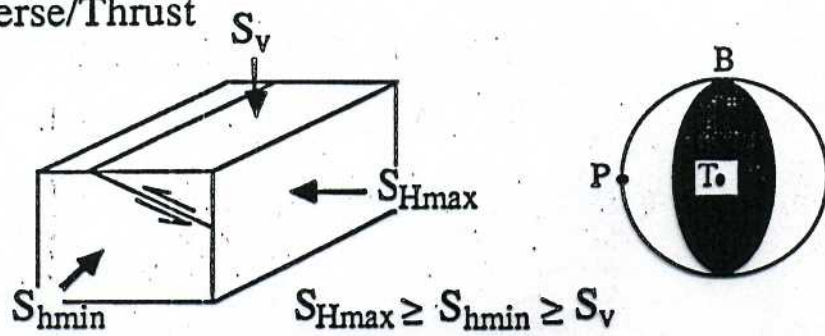
$$\delta = 62^\circ$$

$$\lambda = 232^\circ$$

Strike-Slip



Reverse/Thrust



Normal

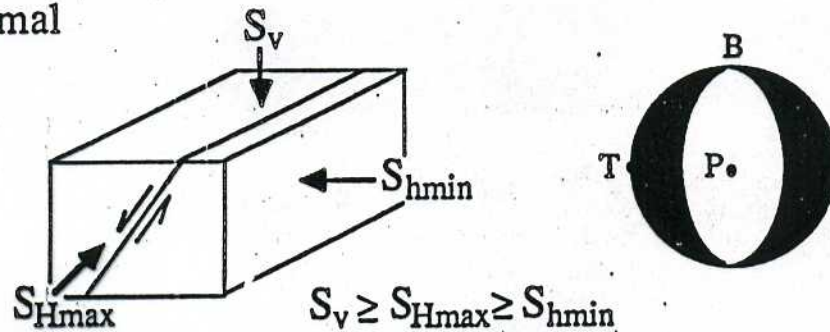


FIGURE 2. Simplified illustration of the various types of faulting, the relative magnitudes of the principal stresses and lower-hemisphere projection earthquake focal plane mechanisms.

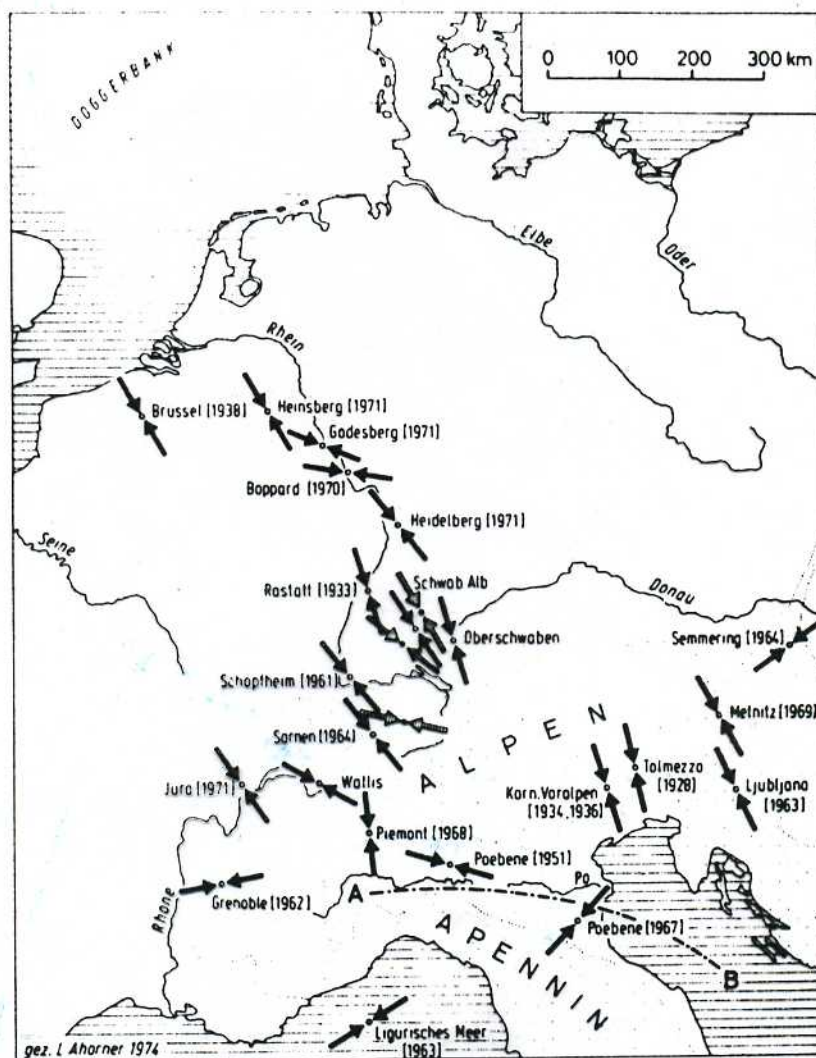


Fig. 10 — Horizontal compressive stresses in Central Europe. Strike of horizontal component of maximum compressive stress is shown at each locality by a pair of arrows. Solid arrows denote pressure axis of earthquakes focal mechanism. (From Ahorner, 1975).

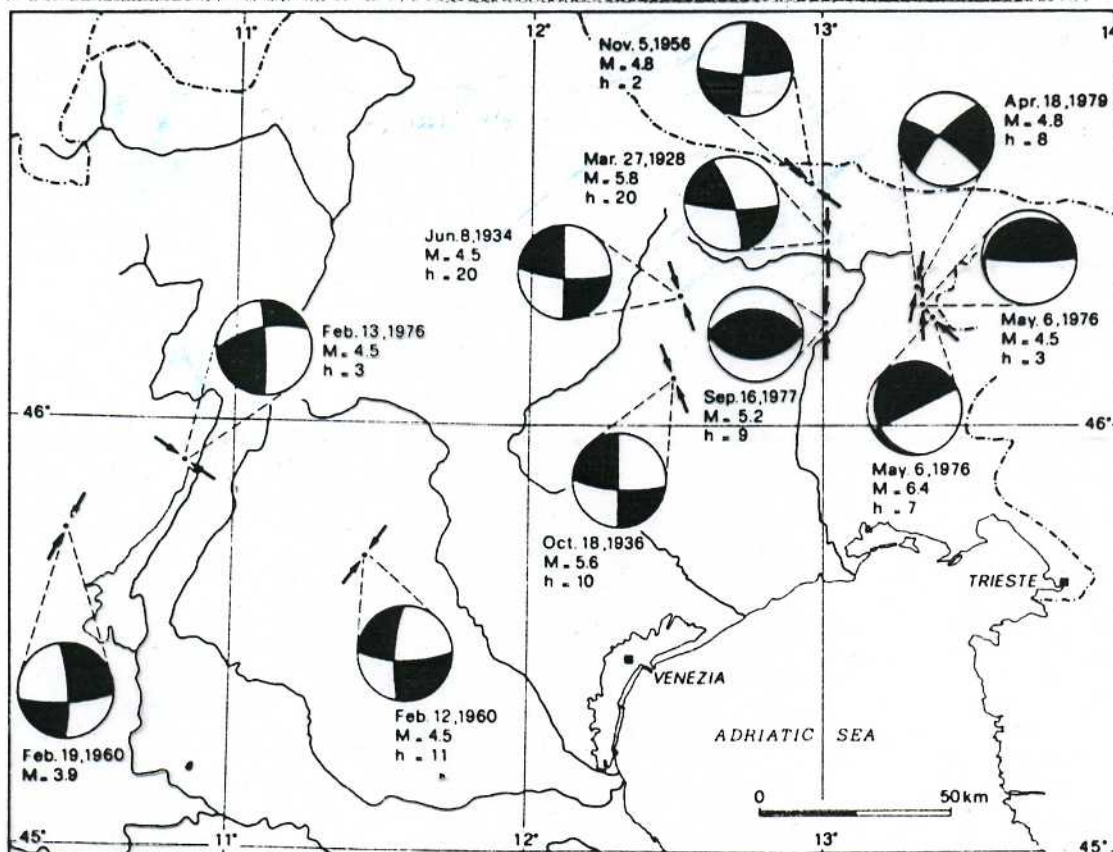


Fig. 9 — Fault plane solutions of earthquakes in the studied area. The solutions are shown as stereographic projection of the lower hemisphere of the first-motion radiation field. Black quadrants denote compressions. (M = local corrected magnitude, h = focal depth). Solid arrows denote axis of

SEISMIC EVOLUTION OF FRIULI EARTHQUAKE

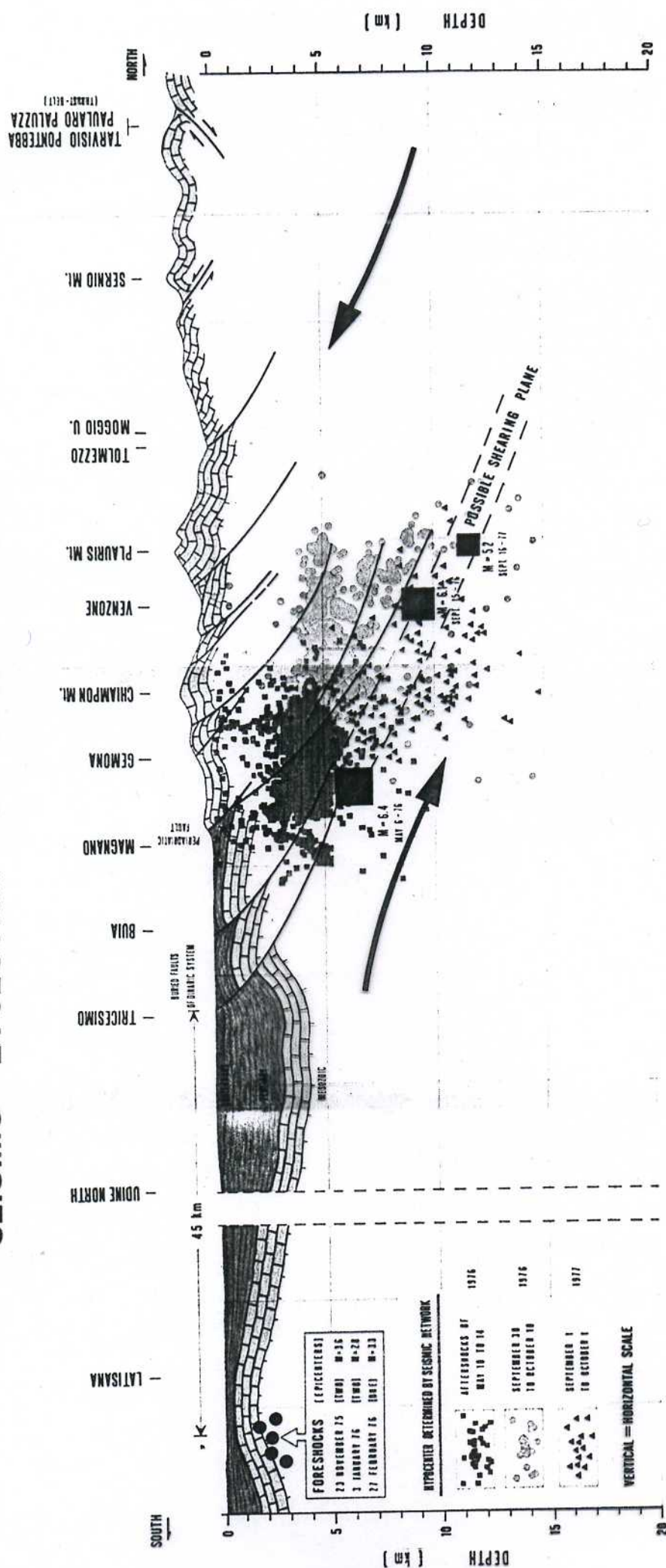


Fig. 2. - SCHEMA DELLA POSIZIONE DEGLI IPOCENTRI DELLE SCOSSE SUCCESSIVE (ESI DAL 6 MAGGIO '76 AL SETTEMBRE '77). I quadrati in nero rappresentano la posizione ipocentrale indicativa delle principali scosse. In verde sono riportati gli epicentri dell'attività sismica delle scosse di assestamento succedute subito dopo il 6 maggio; in granchione quelli dopo il 15 settembre '76, in nero (triangoli) quelli del settembre '77. Si nota un progressivo appiattimento degli epicentri da S-E verso N-O, che potrebbe essere collegato ad un piano di scollamento degli strati soprastanti che ora è imbracciato gli uni sugli altri. Le scosse avvenute alcuni mesi prima del maggio '76 nell'area di Tarvisio sono interpretate come le scosse pre-matutine (foreshocks) del sistema in sovracompressione.

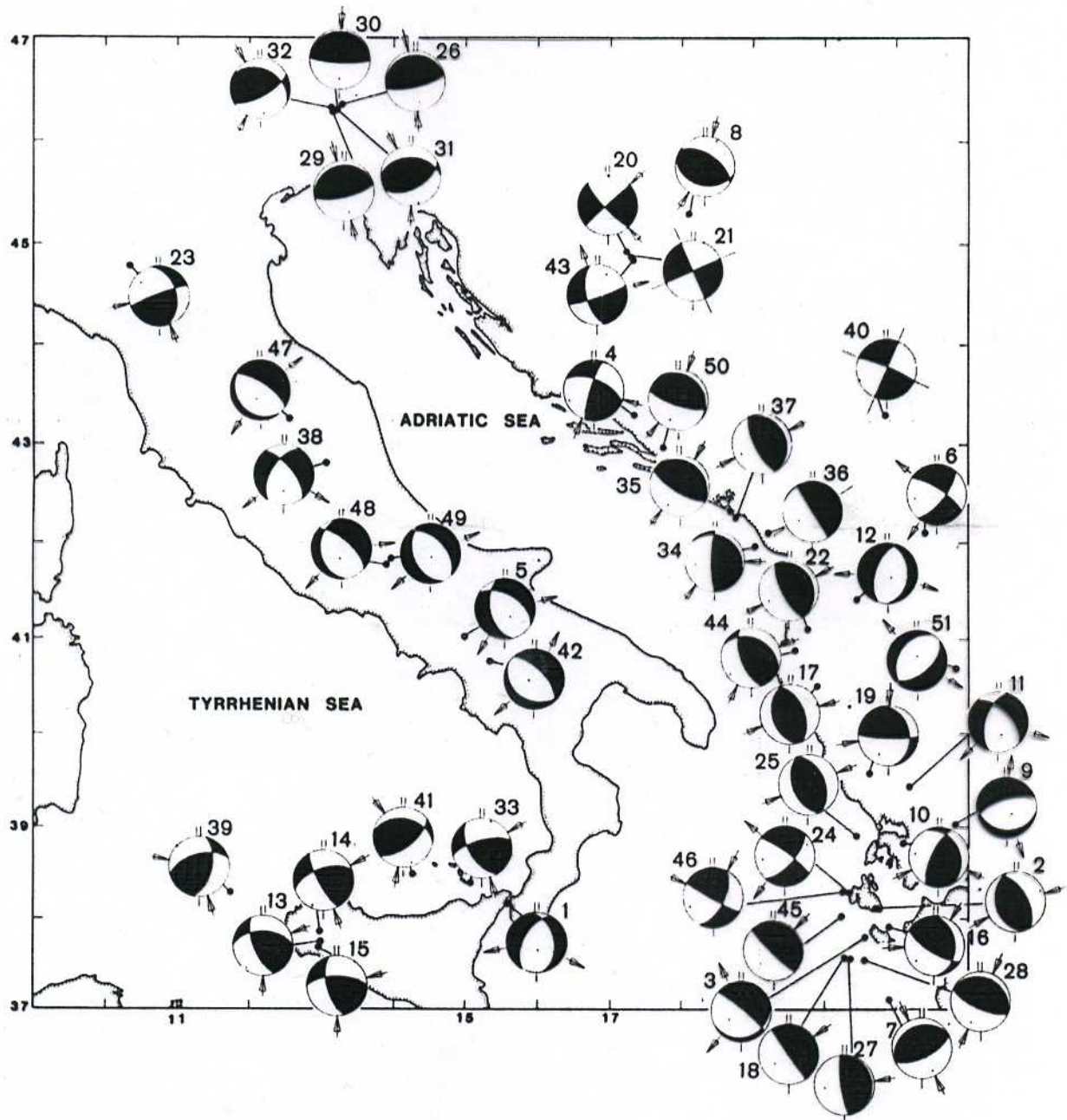
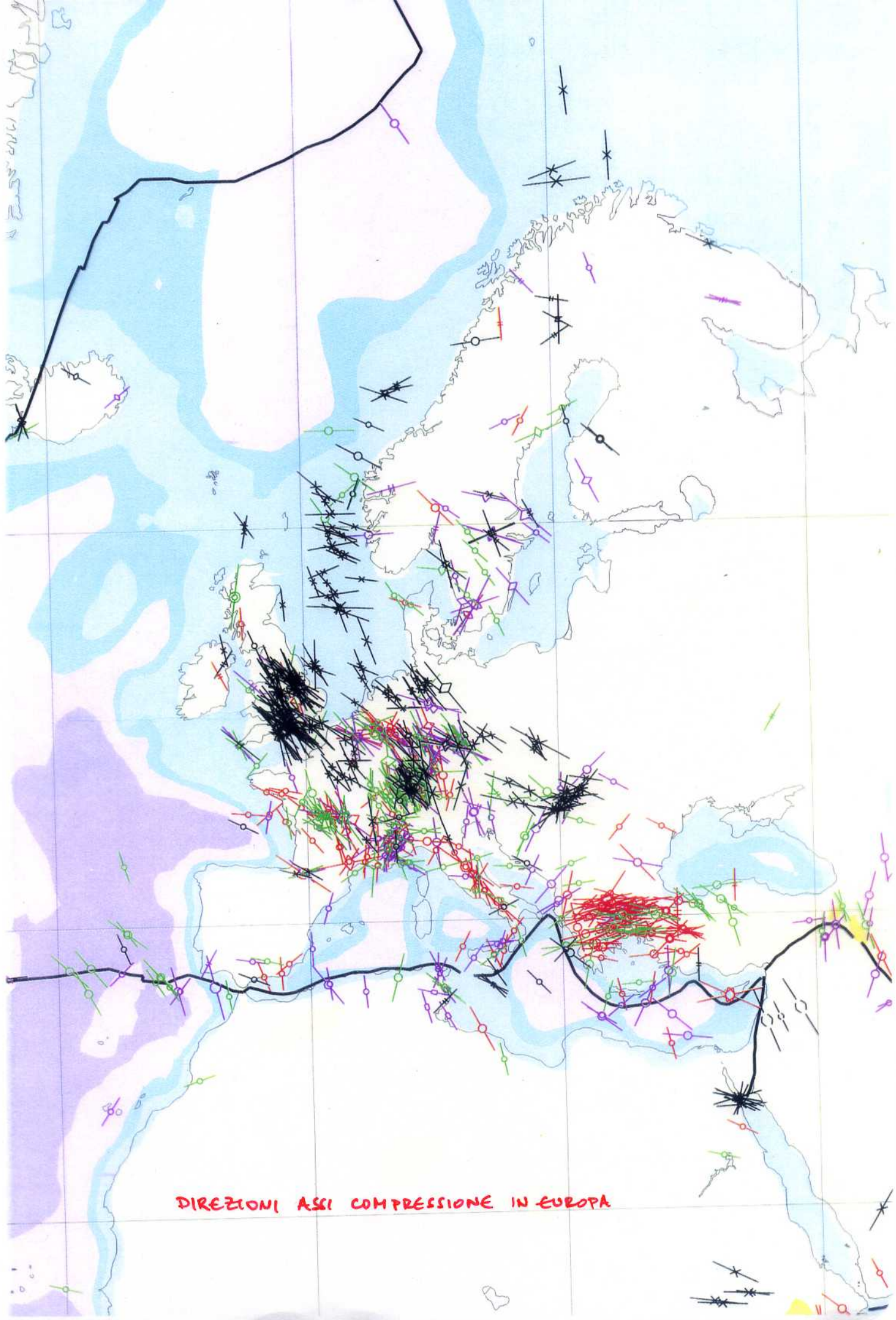


Figure 5. Fault-plane solutions for shallow earthquakes of the peri-Adriatic. Compressional quadrants are shaded and each event is numbered as in Table 1. *P*-axes are shown as a dot in the dilatational quadrant and the horizontal projections of slip vectors are shown as arrows. Location and nodal plane information is given in Appendices 1 and 2.



DIREZIONI ASSI COMPRESSIONE IN EUROPA