Globale Geophysik I

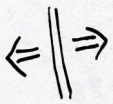
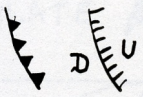
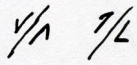
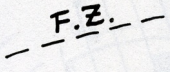
Übungsblatt I

03. 11. 2010

Ergänzung:

Symbole (aus Cox undd Hart 1986)

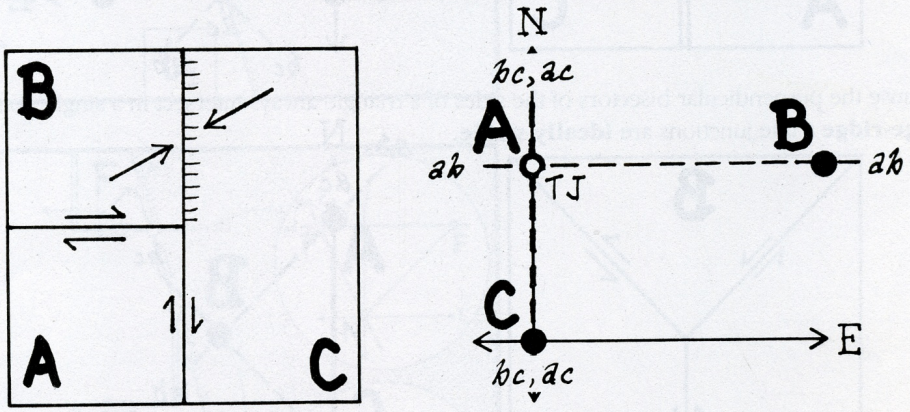
Box 1-7. Definitions and Symbols.

Lithosphere	Rigid outer layer of the earth.
Asthenosphere	Fluid layer beneath the lithosphere.
Plate	Non-deformable block of lithosphere with a perimeter consisting of boundaries of the following three types.
Ridge 	Boundary where two plates are diverging. Along the opening crack, magma rises from the asthenosphere and solidifies on both diverging plates. Ridges are symmetrical in the sense that the two plates usually grow at the same rate. Relative plate motion across a ridge is not necessarily perpendicular to the ridge.
Trench 	Boundary where two plates are converging. One plate moves beneath the other, eventually to be absorbed into the mantle. Trenches are always asymmetrical in the sense that one plate is underthrust, and its leading edge is "destroyed," whereas the other plate is not shortened. Relative motion across a trench is generally not perpendicular to the trench.
Transform 	Boundary along which plate motion is exactly parallel to the boundary. Lithosphere is neither created nor destroyed along a transform. Geometrically, transforms are always circles concentric about the Euler pole for the two plates. In the limiting case of a pole at infinite distance on a plane, the transform is a straight line.
Euler Pole 	The pivot point about which two plates rotate relative to each other. The Euler pole is the only point that does not move relative to either plate. The Euler pole for two plates may be found by constructing perpendiculars to local segments of their transform faults.
Fracture Zone 	Narrow submarine mountain range marking the location of a present or past transform. Both active and inactive fracture zones are concentric about the Euler pole.

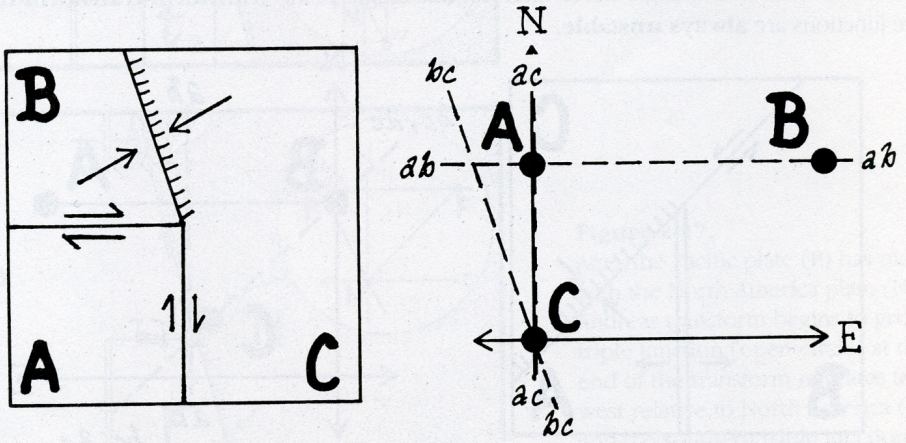
Stability of triple junctions:

Box 2-9. Migration of Triple Junctions.

A triple junction is a point where the three plates, A, B, and C, meet. It is also the intersection of the boundaries between the three pairs AB, BC, and AC. The velocity of any point moving along one of these boundaries will lie on a line in velocity space (Box 2-8). Three such lines (*ab, bc, ac*) describe the velocities of marbles moving with all possible velocities along the three boundaries intersecting in a triple junction. Since the triple junction is like a single marble rolling simultaneously along the three boundaries, it lies at the intersection of *ab, bc,* and *ac.* If these lines intersect in a single point, the triple junction is stable. This means that as time progresses, ridge, transform, and trench boundaries will remain the same and the angles between them will not change. If *ab, bc,* and *ac* do not intersect at a single point, the triple junction is unstable and will exist only for a moment, after which a different plate geometry will evolve (Figure 2-16). The following examples and analyses should help.



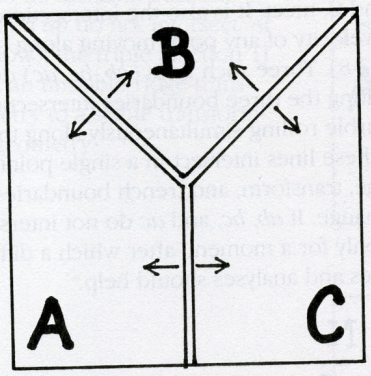
1. Because *ab* and *ac* must both pass through **A,** this **trench-transform-transform** triple junction is **stable** only because *bc,* which must pass through **C,** also passes through **A.** This means that for a trench-transform-transform triple junction, the trench **must have the same trend** as one of the transforms.

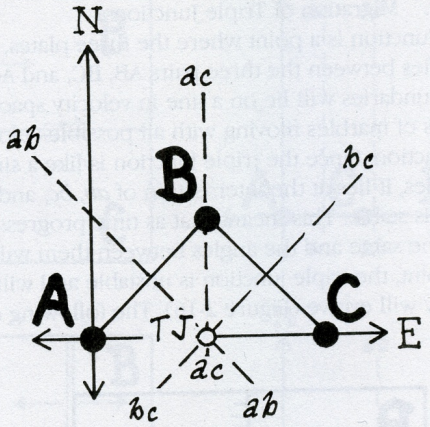


2. If the trench of a **trench-transform-transform** triple junction **does not have the same trend** as one of the transforms, the triple junction is always **unstable.**

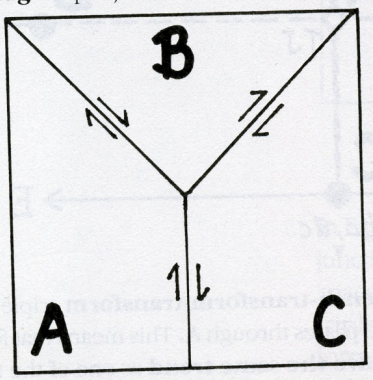
(continued)

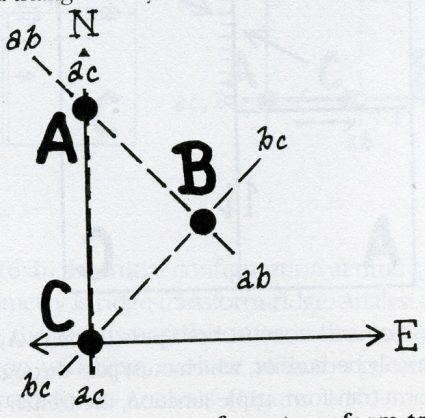
Box 2-9. *(continued)*



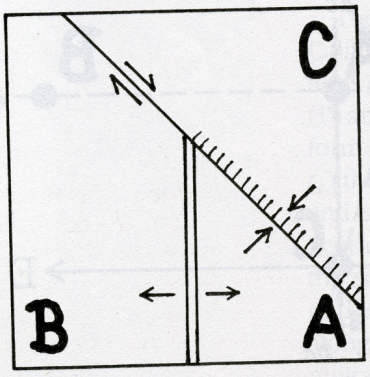


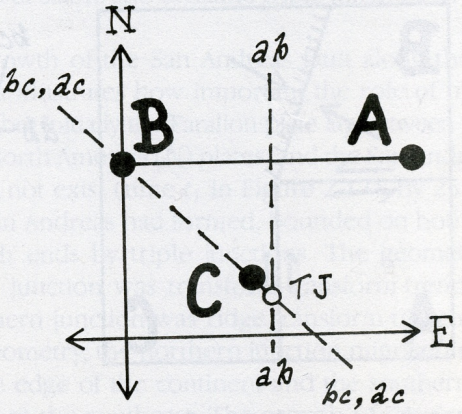
3. Because the perpendicular bisectors of the sides of a triangle always intersect in a single point, **ridge-ridge-ridge** triple junctions are **ideally stable.**





4. Because the sides of a triangle never intersect in a single point, **transform-transform-transform** triple junctions are **always unstable.**





5. Because both *bc* and *ac* must pass through **C,** this **ridge-trench-transform** triple junction is **stable only if** *ab* also passes through **C or** *ac* is equal to *bc* (trench and transform have the same trend), as is shown here.

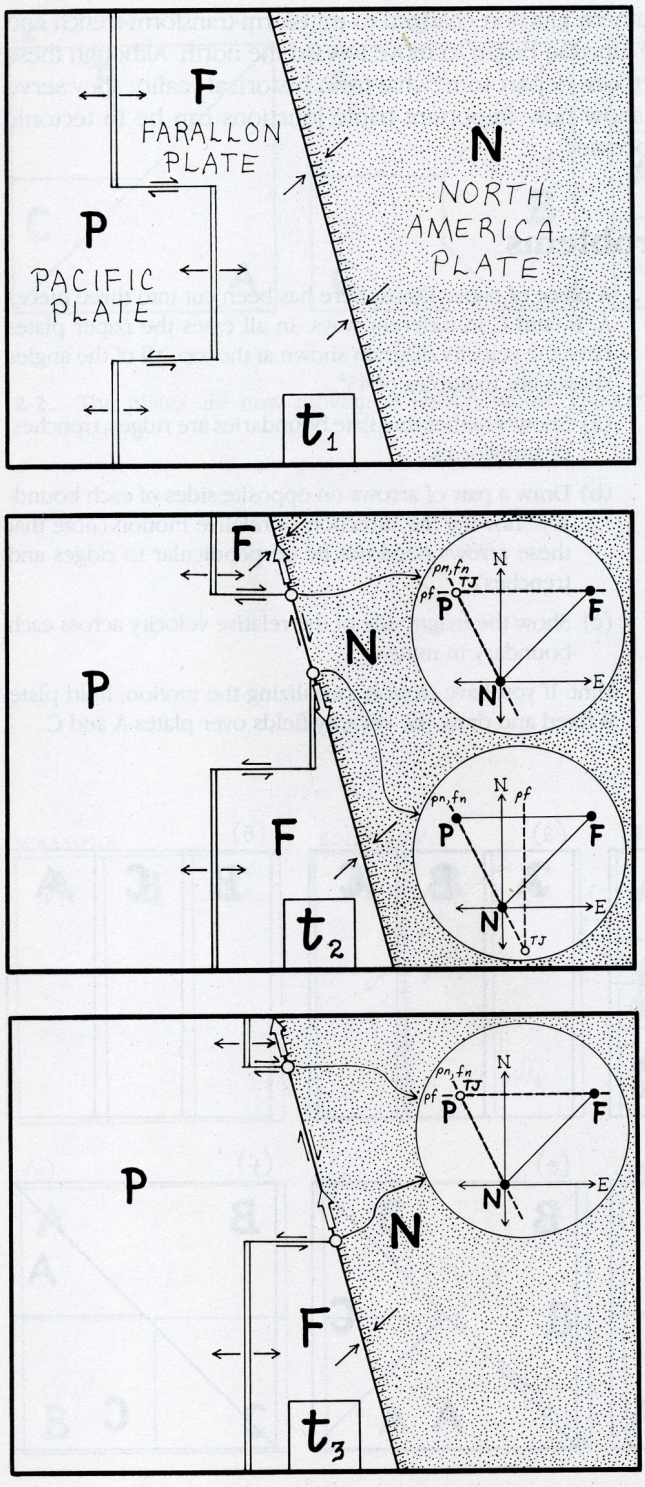
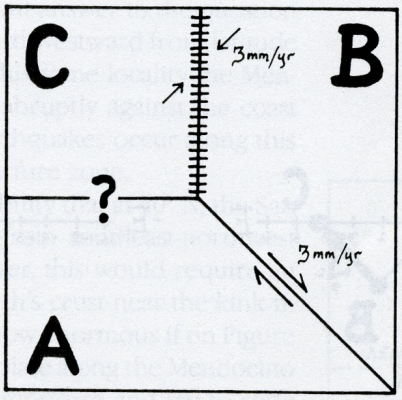


Figure 2-17.
After the Pacific plate (P) has made contact with the North America plate (N), the San Andreas transform begins to grow (t_2). The triple junction (open circle) at the northwest end of the transform migrates to the northwest relative to North America (open arrow) and the southern triple junction migrates to the southeast. When the geometry of the southern triple junction changes (t_3), the southern junction begins to migrate toward the northwest.

Aufgabe 1)

Box 2-7. Making and Interpreting a Velocity Triangle.

The Problem



The AB boundary is a transform with right-lateral movement of 3 mm/yr. The BC boundary is a trench along which convergence is occurring obliquely at an angle 45° east of north.

1. Plot the motion of A, B, and C in velocity space.
2. Holding plate A fixed, plot the vectors on plates B and C showing their velocities relative to plate A.
3. Decide whether the boundary between plates A and C is a ridge, trench, or transform.
4. Find ${}_A\mathbf{V}_C$.

(continued)