d11 Transform-fault plate boundaries

< transcurrent faults that end abruptly >

> The tenor Enrico Caruso, wandered the ruins [from the still standing Palace Hotel] muttering: "Ell of a place! Ell of a place!"
>
> —*The Great San Francisco Earthquake* [5:13 a.m., April 18] *and Fire of 1906*.[1]

Faults with large horizontal displacement join between offset mid-oceanic ridge segments (***Figure d11.1***). Bathymetry shows that their fault trace continues on.[2] The fault movement, as is revealed by earthquakes, is restricted to between the ridge segments (or to between a ridge and a trench if the fault joins these). This was a major puzzle in the1950s when bathymetry had advanced beyond the capability of marine geology to explain. (Even by 1959, deepsea samples were but a few thousand cores, up to 35 m long, of sedimentary rocks and a few grab samples of volcanic rocks.)[3] Even so, in J. Tuzo Wilson's nimble and acquisitive mind, Hess' seafloor-spreading hypothesis allowed for an explanation that Alan M. Coode gave him, February 1956:[4] These faults become, each at its displacement termination, a ridge or a trench (***Figure d11.2***). Later in 1965, Wilson proposed for such the name *transform fault*, a "special class of faults ... that are connected into the continuous network of mobile [*sic*: orogenic] belts about the Earth which divide the surface into several large rigid plates [***Figure d11.3***]." His words "rigid plates" that refer to no evident flow-deformation away from ridge lines, anticipated plate tectonics.[5]

Where a transform fault cuts through continental crust, prolonged movement on it will open an ocean where it transforms into a ridge and shear part of a continent to oceanic isolation or the reverse. Examples: California's San Andreas fault that cuts east of Los Angeles (***Footnote d11.3***) and New Zealand's Alpine fault.

Where a transform fault cuts through a sedimentary basin transpressional or transtensional movement on it can result respectively in what petroleum geologists call "positive- or negative-flower" structures (as seen in map view) with an upward splay of faults described respectively as "palm-tree" or "tulip" (as seen in transverse section). Example: the North Anatolian transform fault that forms the northern boundary of Turkey's Aegean-Anatolian plate and accommodates its westward escape by dextral strike-slip movement). ❑

Figure d11.2 **John Tuzo Wilson** (1908-1993)
a past master at conjuring up terms and concepts that help lesser minds think and imagine: as "transform fault" which says so much more that just transcurrent fault or strike-slip fault; as what became called the "Wilson Cycle" (*see* Topic *j23*).

A fragment of a note, Tuzo kept as a treasured memento of a prospector he was able to rescue while working in a remote field area in his youthful days as a geophysicist for the Geological Survey of Canada, reads:[6]

Ben Germain Aug 7 1938
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in the rapes
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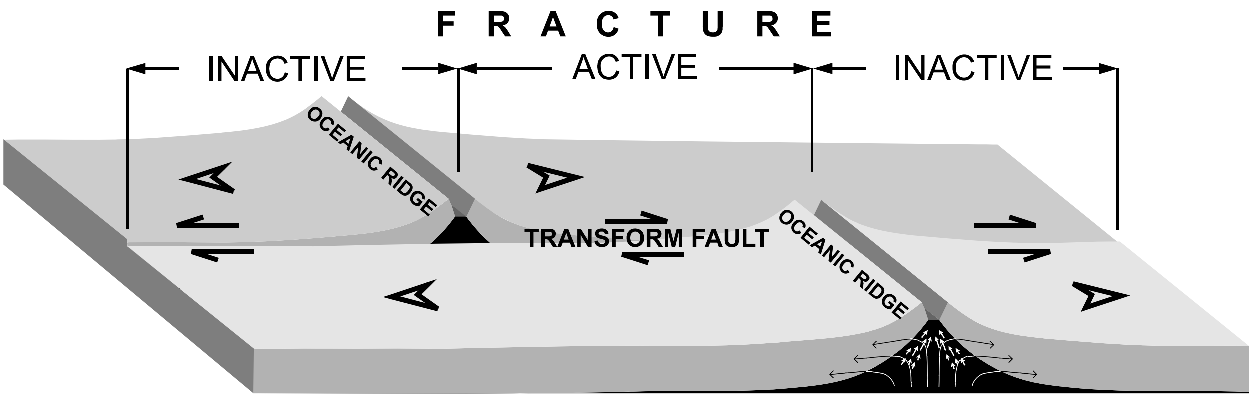
Illent with sand on it
tell the plan com ...

In Rachel Laudan assessment,[7] Wilson lived the ideal of T. C. Chamberlin's "method of multiple working hypotheses" when, during the late 1950s and early 1960s, he assessed the strength and weakness of the research programs and contributed to the development of three rival hypotheses simultaneously: the contraction theory, the expansion theory, and the convection current theory.

Footnote d11.1

In 1906, when faults were all thought to be essentially either normal or reversed, a surprise finding after the great earthquake of San Francisco by François Emile Matthes was that the surface trace of a nearby fault, which had moved, showed only horizontal displacements of features across it.[8] This fault had been named the *San Andreas fault* by Andrew Cowper Lawson in 1895 after the name of a “sag pond” near San Francisco that it skirts.

Figure d11.1 [9] Transform fault joining between offset oceanic-ridge segments.



Beneath and towards ridges is a focused flow of magma (white arrows) in melt bands that develop in the shear of the flow field (arrowed thin lines).[10]

Figure d11.3 [5a] Diagrams of the six possible types of dextral (their mirror image would be sinistral) transform faults after a period of time from an original state (shown below for each).

Dashed lines are traces of parts now inactive but still expressed in the topography.