Structure maps I: making a structure map

Geologists working with subsurface data commonly need to make structure maps, which are maps using contours to show the configuration of stratigraphic surfaces. One begins this effort by compiling tops (relative to sea level) from logs of boreholes (see the *PG&SG* page on "Picking tops") and plotting them on a map. In Map A at right, our pick from "Picking tops" is shown in red as a reminder of whence we have come.

The geologist's task is to contour these data in a manner compatible with the rheological behavior of sedimentary strata, which are slightly, but only slightly, ductile in the subsurface. Most geologists are taught to make contour maps by contouring data from topographic surfaces, which are continuous surfaces that are commonly incised by streams. The result is a map like Map B, which has kinked contours suggesting sharp bends that are unlikely to form in layers of sedimentary rock. Thus the topographic model is a less-than-useful model for contouring of structure maps, and one that suburface geologists commonly must unlearn.

If one contours the data in Map A so as to avoid kinks (a good thing) and to maintain a continuous surface (not necessarily a good thing in subsurface mapping), one may arrive at a map like Map C. This map has curving rather than kinked contours, but presents a surface unlikely to form in the folding of a layer of sedimentary rock: slopes change abruptly from gentle to steep (see the areas shaded red), folds are tight, and fold axes bend sharply and/or diverge.

The closely spaced contours in the red areas of Map C would require tight folding of a layer of sedimentary rock. A not-very-ductile and instead relatively brittle layer of sedimentary rock would instead be likely to break to give a fault (and thus a discontinuous surface). An experienced subsurface geologist would look at the three problematic red areas in Map C, which form a line, and say "Let's try putting a fault there".

Map D is a more reasonable geological interpretation of the elevation data in Map A. The stratigraphic surface is folded gently and faulted, both of which are reasonable assumptions about the behavior of layers of sedimentary rock (whereas as Map C would require sharp folding not consonant with our understanding of how layers of sedimentary rock behave as they are deformed). Map D thus presents the most *geologically* parsimonious interpretation of the data.