Maps of lineaments, lineament intersections,
and hydrothermal alteration in
Northern Sonora, Mexico

Gary L. Raines
U. S. Geological Survey, Denver, Colorado

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This report is preliminary and has not been edited or reviewed
for conformity with U.S. Geological Survey standards and
nomenclature.

As a preliminary step in an exploration program, I have
performed two types of analyses. The first is an analysis of
linear features seen on Landsat images in order to define
regional tectonic patterns, and the second is regional mapping
of alteration using digital image processing techniques as
described by Rowan and others (1974). Map 1 shows the results of
these analyses. This map shows areas of complex intersections,
defined below, and areas of hydrothermal alteration as seen
on color-ratio-composite images of Landsat images.

For the analysis of linear features a lineament map was
made from Landsat transparencies at a scale of 1:1,000,000
by photogeologic methods. Map 2 shows a filtered version of
the original lineament map. This map has been filtered and
replotted for statitical analysis purposes; consequently,
all lineaments are represented as straight-line segments that
approximately follow the lineaments drawn on the images.

Using a statistical analysis procedure developed by
Sawatzky (in Knepper, 1974, p. 129-132), three statistically
significant trends were defined. Map 3 shows the lineaments
not included in these statistically defined intervals and Maps
4-6 show the lineaments included in the statistically

1.

defined intervals. Sawatzky's procedure assumes that the number

of observations in each direction is independent of the number

of observations in any other direction, and each possible direction

is equally likely. Therefore, knowing the total number of

observations, and the expected number of observations, the

probability of making a particular number of observations in any

direction can be calculated using the binomial probability

theory. Thus, a statistically significant direction is one

with a number of observations that is statistically improbable

in a random situation.

Maps 7-10 present a more useful way to study these

lineaments. These maps show contoured spatial concentration

of lineaments in each statistically defined interval and for

all lineaments.

Map 11 shows the contoured spatial concentration of the

northwest and northeast trends. These two trends seem to be

the most significant regional structural controls of minerali-

zation, as discussed in Raines (1976). The areas of complex

intersections of lineaments of these two important trends are

here defined as those areas within the upper quartile of con-

centration, the 250 contour, on this map.

2.

Map 12 can be used to register these maps on available 1:1,000,000 scale maps of Sonora, Mexico.

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Explanation of Maps:

All of these maps are preliminary working maps. Changes in these maps will undoubtedly be made as my work continues.

Map 1: Complex intersection and hydrothermal alteration map. This map is derived from Map 11 with the addition of hydrothermally altered areas as interpreted from color-ratio-composite Landsat images. The areas of complex intersections are the upper quartile of concentration of the northwest and northeast trends of lineaments and are marked in black. The A's denote areas of hydrothermal alteration.

Maps 2-6: Filtered version of the lineament map that was derived by photogeologic methods. The filtering removed the high frequency variations of the lineaments so that each lineament is represented on the map by a straight line segment which approximately follows the original lineament. The specific directions plotted: Map 2 - all lineaments, Map 3 - "Nonsignificant Directions" Map 4 - 20° to 57° or N20E to N57E,

Map 5 — 321° — 356° or N39W to N4W,

Map 6 — 276 — 290 or N84W to N70W. The "Non-

significant Directions" are those lineament trends

not included in the intervals statistically defined

as significant.

Maps
7-10:   Maps showing contoured spatial concentration of

            lineaments. The spatial concentration is defined as

            the number of times that a lineament falls within a

            grid cell of preselected size, 0.3 inches on a map at

            a scale of 1:1,000,000, normalized to relative frequency,

            per unit area of the grid (D.L. Sawatzky, oral communication,

            1976).

Map 11:   Contoured spatial concentration of lineaments of the

            northwest and northeast trends. The highs are defined

            here to be areas of complex intersections of lineaments.

Map 12:   Location map at a scale of 1:1,000,000 that can be

            used to register the previous maps on to available

            1, 1,000,000 scale maps.

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