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IRON-ABSORPTION BAND ANALYSIS FOR THE DISCRIMINATION OF IRON-RICH ZONES

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Type I Progress Report - ERTS-A

a. Title: Iron-absorption band analysis for the discrimination of iron-rich zones

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b. GSFC ID no. of P.I.: 1345

c. Problems relating to progress:

Analysis of new, computer-generated, ratio images of the western half of the Goldfield, Nevada ERTS frame (no. 1072-18001) was delayed due to image registration problems. The necessity of color compositing to attain maximum discrimination makes precise registration of the images critical. The third set of ratio images produced by the computer finally provided satisfactory registration.

A field trip during the week of April 28th resulted in the collection of over 500 visible and near-infrared in situ spectra from two spectroradiometers. One instrument was designed and fabricated by Alexander Goetz at the Jet Propulsion Laboratory and scans from 0.40 to 2.5 μm in about 30 sec; data are recorded on digital tape. The other spectroradiometer was constructed by William Bonner, U.S. Geological Survey, Denver, Colo; scanning from 0.40 to 1.4 μm is achieved in approximately 2 sec, and recording is on analog tape. Although this was the first operational use of these instruments, only minor electronics problems were encountered. Cloud cover prevented collection of spectra on one day; however, a detailed examination of the geology of the Goldfield mining district and an overflight of the western half of the Goldfield ERTS frame was possible instead.

Sixty color prints of a NASA overflight of Goldfield and much of the surrounding area were processed in time for the field trip. However, color reproduction was so poor that the prints were returned after the trip. Replacements still have not been received.

d. Discussion and plans:

Spectra collected during the one week field trip are being processed and should soon be available for analysis. Chemical and mineralogical compositions will be determined for samples collected at the sample sites. These ground spectra will be compared with existing laboratory spectra of similar rock types, and the differences will be evaluated. In addition, the relative merits of the two field spectroradiometers will be evaluated. The spectra collected in the field will also be used to calibrate the digital MSS data so that spectra can be calculated directly from the MSS tapes.

Further computer processing of the western half of the Goldfield frame is planned. Variations in the atmospheric correction factor and in the amount, kind and position of the stretch will be examined. The diazo process and an I^2S viewer will be used to determine the best balance among these variables for maximum discrimination potential.

A color-ratio composite of the western portion of the Goldfield frame was produced using the same combination of ratio images and colors as used for the eastern part. A June field trip is planned for the examination of the color anomalies seen on this composite.

Evaluation of the nature and significance of large and small lineaments determined from an ERTS image-mosaic of Nevada at 1:1,000,000 scale continues. A reevaluated version of the large lineaments and linear zones, has been digitized, and statistical tests with respect to azimuth frequency are being carried out. In addition, the areal distribution of ore deposits and volcanic centers will be contoured by computer. Results will be evaluated with respect to the lineaments.

e. Results and applications:

A derivative overlay of the 360 large lineaments, and linear zones (Rowan, 1974) has been completed showing (1) lineaments and linear zones which correlate with mapped faults (2) lineaments and linear zones which do not correlate with mapped faults and (3) lineaments and linear zones which are extension of mapped faults. The correspondence of the mapped faults with the lineaments and the linear zones indicates an 80.6% agreement. Correlation of a fault with a lineament was determined on the basis of an approximate parallel trend and a location within one line width (about 1/2 km) of the related lineament. Lineaments and linear zones which represent extensions of mapped faults were noted as such on the overlay and were counted as correlations. Lineaments and zones which showed no relationship with a known fault numbered 70 or 19.4%. These particular linear features will be examined in greater detail.

The majority of lineaments and linear zones appears to represent marginal faults of the typically north-northeast to north-northwest trending fault-blocked mountain ranges of the Basin and Range province. The linear features on the ERTS images do not necessarily pick up the actual fault trace, but frequently represent the topographic expression (i.e. escarpments or mountain ridges) of the fault. The second most common nature of the lineaments and zones are linear mountain ridges. Other causes of linear features include stream segments, linear tonal changes and topographic breaks within the mountain ranges.

Information pertaining to the largest of the 16 potential new volcanic centers delineated on the ERTS image-mosaic of Nevada is being compiled. This suggested center is approximagely 150 km in diameter and is located in central Nevada (fig. 1). Although the morphologic boundary is slightly vague on the ERTS mosaic, several independent lines of geologic and geophysical evidence seem to support the geologic significance of this feature. Geologic maps of the area show the presence of a thick, widespread sequence of Tertiary ash flow tuffs and flows and 14 Tertiary volcanic centers, including 4 calderas, within this feature. In addition, several Quaternary volcanic centers, including Lunar Crater, occur within the area. This density of volcanic centers is higher than in most parts of the state. Heat flow measurements (Sass and others, 1971) show a relative low in this part of Nevada, but the areal density of these data is quite sparse.

Lineaments and faults are especially complex within this circular feature, and many of the longest lineaments, including the Oregon-Nevada

Lineament (John H. Stewart, George W. Walker and Frank J. Kleinhampl, written communication) appear to intersect near the center of this feature. None of these lineaments transgress this feature but instead appear to terminate within the defined circular area.

Unpublished aeromagnetic data clearly defines a regional magnetic low which is generally coincident with the boundary shown on the mosaic (fig. 1). Within this regional low are numerous small magnetic highs and lows. Regional gravity data show that this circular structure (fig. 1) is nearly coincident with the western part of an intense corrected negative Bouguer anomaly (Mabey, 1966). Elevated terrain in the anomalous area led Mabey to conclude that this is an area of crustal thickening and at least partial isostatic adjustment. However, the presence of a thick pile of low density sialic volcanic rocks in this area could also account for this gravity anomaly. We suggest that this may be the site of intense Tertiary volcanic activity, probably partially controlled by the intersection of major fracture and fault zones.

A diazo color composite of the western half of the Goldfield ERTS frame has been prepared using logarithmically stretched ratio images without atmospheric scattering correction. As in the composite for the eastern part of the frame, the ratio images and colors used were 4/5 (blue), 5/6 (yellow) and 6/7 (magenta). Other color and ratio combinations, especially using the inverse ratios (5/4, 6/4, 6/5, 7/4, 7/5, and 7/6), were examined, but none showed any improvement over the discrimination potential of the original color and ratio image combination. Images with atmospheric correction were not used for the final composite because the resulting composites were too noisy.

Color prints of the above composite were prepared at 1:500,000 scale and were used along with a geologic overlay for a reconnaissance overflight during the April field trip. Anomalous color patterns seen on the prints were identified on the ground from an altitude of about 10,000 feet. Limonite-stained or hightly bleached rocks showed as green anomalies. Mining was sometimes associated with the green anomalies. The orange hues seemed not to be as reliable an indicator of vegetation as in the eastern half of the Goldfield frame. These and other discrepancies will be examined on the ground during the proposed June field trip.

References:

Mabey, D. R., 1966, Regional gravity and magnetic anomalies in part of Eureka County, Nevada, in Mining Geophysics, vol. 1, Case Histories: Soc. Exploration Geophysicists, p. 77-83.

Rowan, L.C., 1974, Iron absorption band analysis for the discrimination of iron-rich zones, Type I Progress Report for Period 1 January - 28 February, 1974, NASA/Goddard Space Flight Center.

Sass, J. H., Lachenbruch, R. J., Munroe, R. J., Greene, W. G. and Moses, T. H., Jr., 1971, Heat flow in the Western United States, Journal of Geophysical Research, vol. 76, no. 26, p. 6376-6413.

f. Reports:

None

g. Changes in operation:

None

h. Changes in standing order forms:

None

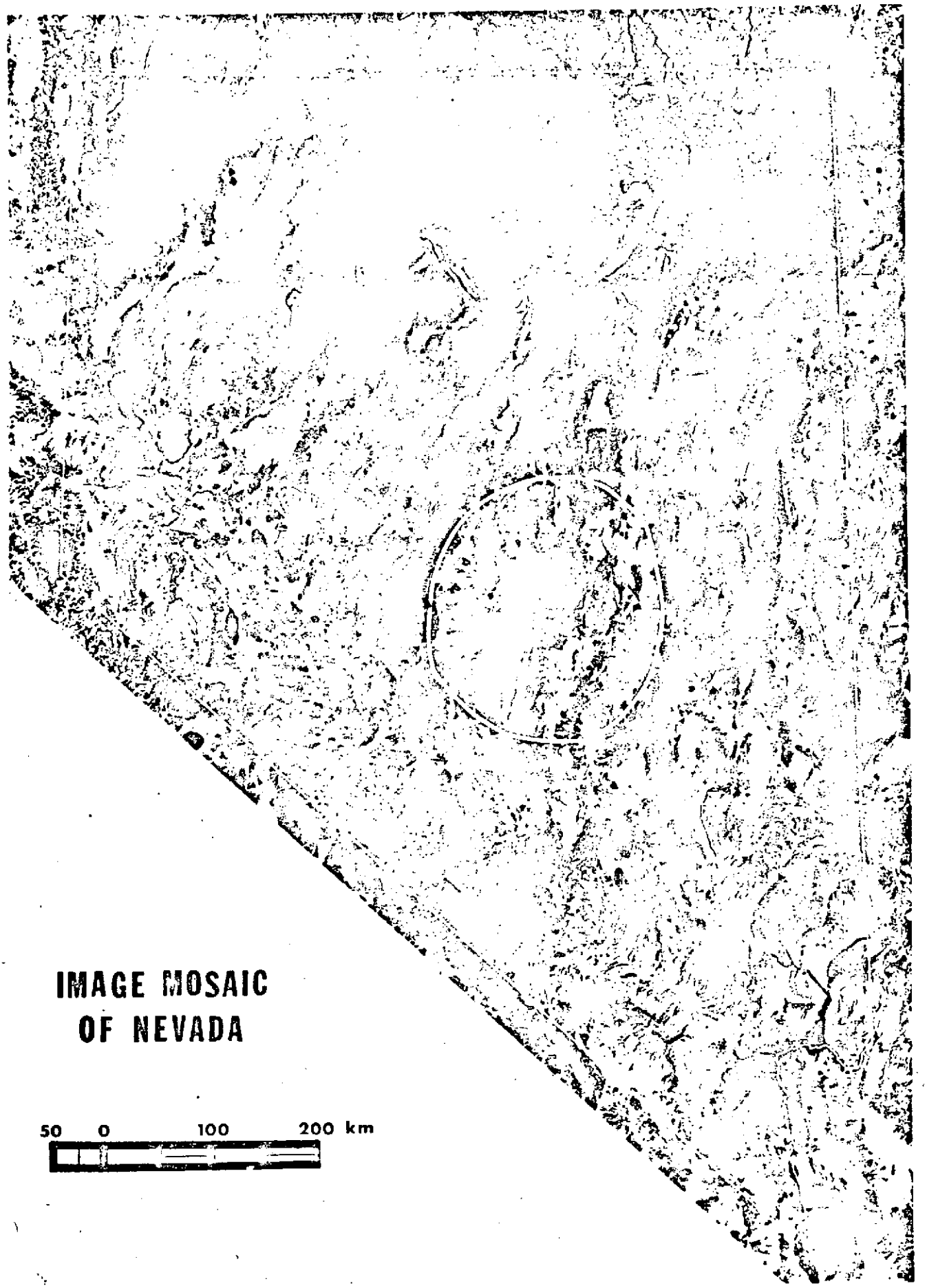
i. ERTS Image Descriptor forms

None

j. Data Request forms:

No change

Fig. 1 - ERTS-1 band 5 mosaic of Nevada showing location of large circular structure. Mosaic prepared by Aerial Photographers of Nevada, Reno, Nevada.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