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THE USE OF ERTS/LANDSAT IMAGERY IN RELATION TO
AIRBORNE REMOTE SENSING FOR TERRAIN ANALYSIS
IN WESTERN QUEENSLAND, AUSTRALIA

ERTS FOLLOW-ON PROGRAMME STUDY NO.2692B
(29650)

QUARTERLY REPORT

by

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1. Introduction

The investigations cover the Gregory River - Mt Isa - Cloncurry - Dobbyn area of western Queensland, Australia.

The aim is an evaluation of ERTS/LANDSAT 1 and 11 imagery taken at different seasons of the year, namely March, July, September and December, for analyses of features of the natural terrain with particular reference to geological mapping and mineral exploration. The imagery is being evaluated in relation to airborne imagery of selected areas and interpretation is being verified by the ground truth investigations.

2. Techniques

The techniques outlined in the previous report have been followed. Additionally for selected areas plates covering four grid sections have been used for the projection of larger areas at the 100,000 scale. Colour prints, produced at a scale of 1:250,000 have been used for the identification of faults and linears and for the mapping of lithological/stratigraphical units in the Dugald River and Lady Annie areas.

The computer compatible tape of the frame 1D 2039 - 23555 for March 1975 has been used to generate a colour composite of the Dugald River area projected at a scale of 1:50,000. This contains more distinctive spectral signatures than the one generated from the negatives and projected at the same scale;

the definition is also better. This improvement has been obtained by a combination of density stretching and slicing techniques, the parameters being adjusted according to the actual density ranges on the tape.

3. Accomplishments

The interpretation procedures outlined in the report for the period ended March 1976 have been completed for grid section 22, the Cloncurry Plains, of the Cloncurry - Dobbyn frame (1D 1151-00073) for 22.12.1972, of the Cloncurry-Dobbyn frame (1D 2039-23555) for 2.3.1975 and of the Cloncurry-Williams River frame (1D 2183-23552) for 24.7.1975.

Interpretations of the geology have been completed for grid section 21, the Dugald River area, of the Cloncurry - Dobbyn frame (1D 2039-23555) for 2.3.1975 and of the Cloncurry-Williams River frame (1D 2183-23552) for 24.7.1975. They have also been completed for the Lady Annie-Mt Gordon fault zone area of the Lady Annie - Mammoth frame (1D 2059-00012) for 22.3.1975. Maps showing the geological interpretations have been prepared. Apparent faults and linears have been identified on the same grid sections and maps showing these structures have been compiled.

During the period July/August the features indicated on the grid sections cited above were checked in the field.

On the Cloncurry Plains traverses made across zones with contrasting spectral signatures confirmed that the darker signatures were produced respectively by areas dominated by Acacia cambagei and Eucalyptus pruinosa trees with Triodia pungens grass within a grassland characterized by Astrebla pectinata, Iseilima spp. and Chrysopogon fallax which produced signatures of lighter hue and lighter tone.

In the Dugald River area checking of both the geological interpretation and of the faults and linears which were identified on the imagery confirmed the presence of outcropping Naraku granite along the Corella river, disclosed that some linears coincided with tracks or fence lines and established that others had no apparent surface expression and were probably associated with deep seated structures.

In the Lady Annie area field checking of the geological interpretation and of the faults and linears identified on the imagery confirmed the relationships between spectral signatures and the vegetation, soils and geology and established the unique signature over the area containing the phosphate deposits. Some of the linears recognised on the imagery appeared to have no known surface expression, others appear to be related to mineralized zones. Geobotanical anomalies, hitherto not known, associated with mineralization located in recent drilling, were found.

In the Urandangi area field checking confirmed the identification of areas of dark spectral signatures with burnt vegetation and that of sharp linear changes of spectral signature with fences.

For the Lady Annie - Mount Gordon area four colour composite images have been scanned, digitized and classified using a quadratic decision rule. The four images were acquired on

2 : 3: 73

22 : 3: 75

18 : 9: 75

10 :11: 75

The frame acquired on 22:3:75 was used as the reference frame, training sets were chosen to define six classes, and a supervised classification map generated. The other three frames were then classified by the same method and with training sets located in the same geographic areas as the reference frame but having, of course, different spectral data in each case. The four classification maps were then compared with a view to detecting change in the vegetative cover.

The same procedure and analysis has also been performed for two frames of the Dugald River - Cloncurry area taken on 2:3:75 and 24:7:75.

As part of this signature extension analysis, which in the above examples is concerned with temporal extension, aircraft imagery of the Dugald River area has been examined from the standpoint of the spatial extension of spectral signatures. Six frames with a total separation of 10 kilometres have been classified into ten groups and the appropriate contingency tables constructed.

A supervised classification of this same Dugald River area has also been performed using the CCT and an interactive relocation technique.

4. Significant Results

The following significant results have been obtained:-

- (1) Distinctive spectral signatures are associated with areas of near surface bedrock in areas of covered ground east of the Dugald River area (Cloncurry - Dobbyn frames, 1D 2039-23555 and Cloncurry - Williams River frame 1D 2183-23552) and along the Thornton river valley west of Lady Annie (Lady Annie - Mammoth frames 1D 2059-00012, Mt Gordon - Lady Annie frame 1D 2239-00001 and Mt Isa - Lady Annie frame 1D 2292-23594).
- (2) Linears identified in the Dugald River area (grid section 21) on the LANDSAT II imagery taken in March and July 1975 over the Cloncurry - Dobbyn area, display preferred orientation. In particular there is a well defined group with a NE - SW orientation. The linears in this group are evident both in areas of surface or near surface outcrop and in areas of covered ground.
- (3) An important group of linears, also with a NE - SW orientation has been identified in the Lady Annie area (grid section 23) covered by the Lady Annie - Mammoth frame (1D 2059-00012). The Mammoth mine and the Lady Loretta lead-zinc deposit lie along linears belonging to this group.

- (4) In the Lady Annie area the known copper mineralization in the Mt Kelly area occurs along a well marked linear with a NNW/SSE direction apparent on the LANDSAT II images for March, September and November 1975 (1D 2059-00012, 1D 2239-00001 and 1D 2292-23594). Faults intersect this linear.
- (5) Geobotanical anomalies provide surface expression of the copper deposits in the Mt Kelly area.
- (6) While there were obvious and anticipated temporal changes in the four classified maps of the same area, there was also a surprisingly high degree of common content.
- (7) The results on spatial signature extension using aircraft imagery are considered to be important in relation to mineralization detection and because there is almost no other published work on this subject.

5. Publications

The following paper was read by Professor Cole at the International Geological Congress in Sydney in August:

'The use of multi-spectral and thermal imagery taken at different seasons from aircraft and satellite platforms in the recognition of superficial and bedrock geology, structural features and ore horizons in western Queensland, Australia.'

The following paper has been recommended for publication by the Institution of Mining and Metallurgy, London:

Cole, Monica M. and Owen-Jones, E.S.
'The use of multi-spectral and thermal imagery from satellite and aircraft platforms in the identification of geological structures and ore horizons.'

The following paper was read by Dr. E. S. Owen-Jones at the Annual Meeting of the British Association for the Advancement of Science at Lancaster in August:

'The Detection of Mineralization from Space.'

Following this paper the British Broadcasting Corporation transmitted two talks by Dr. E. S. Owen-Jones:

- (a) On the "Science Today" programme on 18th September and beamed to the United Kingdom.
- (b) On the "Current Trends in Science" series in September and beamed on the Overseas Service.

The following paper will be published in the Journal of the British Interplanetary Society:

'The Use of Landsat Imagery for Terrain Analysis" by B. J. Chandler and E. S. Owen-Jones.

the paper was read at a meeting of the Society on September 15th.

The following paper has been recommended for publication by the Institute of Physics in "Physics in Technology":

E. S. Owen-Jones
'Prospecting from Space.'

6. Problems

No problems have been experienced.

7. Data quality and delivery

Imagery which has been received since the preparation of the last report is given in Table . The repetitive cover requested for different seasons for the Cloncurry - Dobbyn and Gregory River -

Mt Isa areas has not been received.

The computer compatible tape, 1D covering the
Gregory River - Mt Isa area, requested on ,
has not been received.

8. Recommendations

There are no recommendations at this stage regarding the particular project but imagery from a thermal channel and imagery of higher resolution such as that planned from LANDSAT C would provide valuable additional information for this type of terrain.

9. Conclusions

The only additional conclusion at this stage is the importance of the linears which can be identified on the imagery relative to the existence of mineralization.