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AN EVALUATION OF ERTS-1 IMAGERY FOR MAPPING OF MAJOR EARTH FRACTURES AND RELATED FEATURES

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16. Abstract

Fractures of regional extent in the Wind River Mountains of Wyoming were mapped from ERTS-1 imagery. Most previously mapped fractures were confirmed by the ERTS-1 image study, and many new fractures were discovered. In one area, the ERTS-1 imagery appeared to give superior results to ground studies.

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Figure 2. Technical Report Standard Title Page

AN EVALUATION OF ERTS-1 IMAGERY FOR MAPPING OF MAJOR EARTH FRACTURES AND RELATED FEATURES

Objectives

The primary objective of the study was to evaluate the suitability of ERTS imagery in mapping of regional fracture patterns in Precambrian crystalline rocks. Such large scale features are commonly difficult to map in the field because of their great extent. The synoptic overview afforded by satellite imagery appeared promising for studying these features. The Wind River Mountains of Wyoming (Fig. 1) are an excellent test site inasmuch as an extensive Precambrian terrane is well exposed over about 6,000 square kilometers in a relatively unweathered condition.

Regional Geology

The geology of the Wind River Mountains is imperfectly known at present. In fact it is probably the largest area in the contiguous United States which is so little understood. Previous work by myself (Parker, 1961) and others (Richmond, 1945; Baker, 1946; Love and others, 1955; Bayley, 1963; Perry, 1965; Worl, 1968; Barrus, 1968; Pearson and others, 1971; and Granger and others, 1971) had served to outline some local geology, but the sum of these studies is almost trivial on the scale of the whole range, and a more comprehensive understanding of the regional geology was needed.

Methods

Aircraft imagery (Mission 184) was used for a regional reconnaissance of a strip approximately 6 km wide, crossing the Wind River Mountains from west to east (Fig. 1). It was possible to make broad distinctions among a

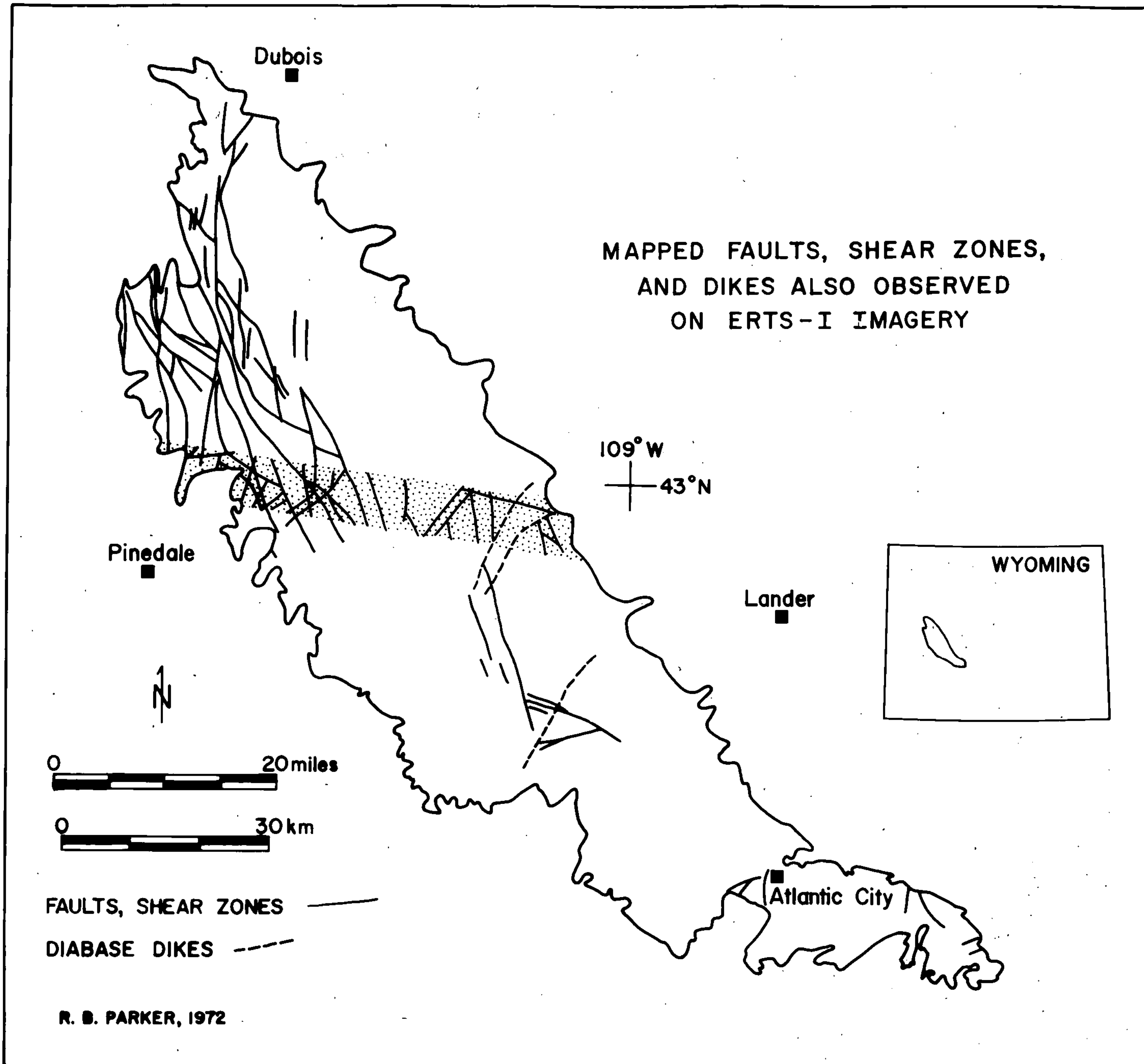

Figure 1

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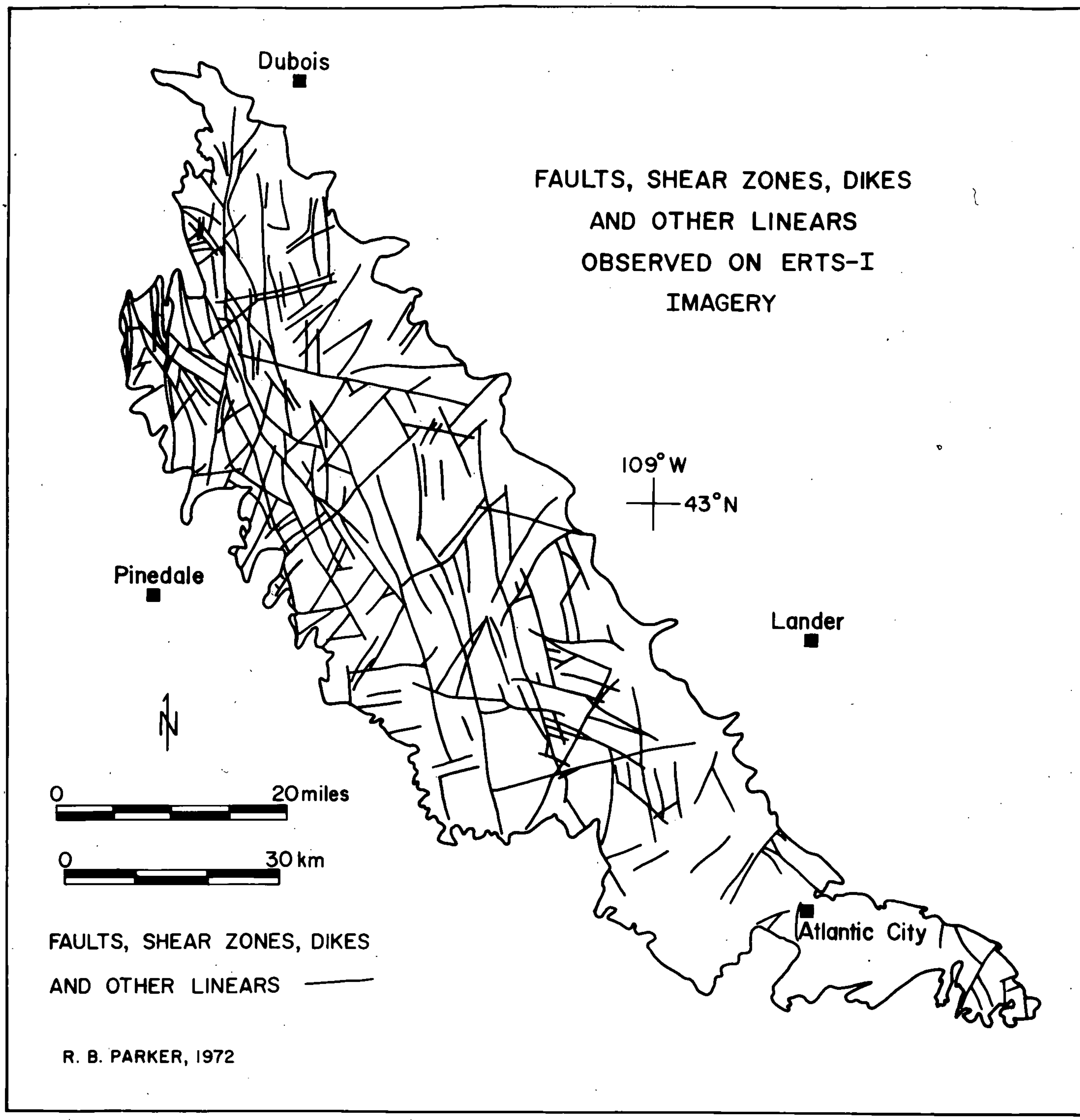

Figure 2

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group of crystalline rocks including gneisses, migmatites, and granites of diverse character. In addition, many linear features were noted which appeared to be fractures or faults of regional extent.

The reconnaissance strip was field checked during August and September of 1972. Access to the area is limited to horseback or foot travel via a limited network of trails. All portions of the test strip could not be examined because of difficulty of access, but sufficient localities were visited to generally confirm the conclusion made from the aircraft imagery.

Description of Fractures

The linears from the aircraft images proved to be major zones of dislocation, cataclasis, and metasomatism or alteration. In two cases they were filled by late diabase dikes.

Most of the fractures are zones of deformation and metamorphism from 10-50 meters wide. The degree of deformation of the rocks in the deformed zone is varied, and rocks range from fine grained submylonites to coarse augen cataclasites. Alteration and metasomatism is equally varied and ranges from weak recrystallization mostly accompanied by epidotization to more completely altered rocks composed almost entirely of epidote. In two cases replacement by pink potassium feldspar is complete with local development of rocks composed entirely of that mineral. A typical fault as seen from the ground is shown in Figures 3 and 4.

The origin of these fractures is not clear at this point. Certainly movement has taken place along the fractures as evidenced by the cataclastic rocks in the fracture zones. They are not merely major joints. On the otherhand, I cannot prove that they are major faults as there are no rock units obviously displaced by the fractures. A more detailed study of the fractures should resolve this question.

21(b)

Figure 3. Fracture crossing the continental divide through unnamed 11,500 ft. elevation pass 2 miles north of Middle Fork Lake. Rocks in the pass are cataclasites extensively replaced by epidote.

Figure 4. Fracture in middle distance crosses ridge in pass. Mt. Bonneville is in distance behind pass. This is the same fracture shown in Figure 3, but some 4 miles to the SSE.

ERTS-1 Imagery of the Fractures

Figure 2 shows the fracture pattern as mapped from the ERTS-1 imagery. For comparison, fractures mapped by previous workers which were confirmed by the ERTS-1 imagery are shown in Figure 1. A number of fractures and dikes mapped by Granger and others (1971) could not be found on the satellite imagery nor did the authors indicate some very prominent linears observed on the ERTS-1 imagery. The large linear indicated by the arrow in Figure 2 is the most striking feature in the entire range on the ERTS-1 imagery, yet is of uncertain significance at this time because it is neither a fault nor a lithologic contact on the map of Granger and others (1971). That area could not be visited in 1972 because of extreme inaccessibility, but a ground study is planned for 1973.

Discussion

The ERTS imagery has provided a means for mapping fractures of regional significance rapidly and accurately. Most of the fractures observed on the ERTS imagery have never been recognized before, either on the ground or from aircraft imagery. We now have a regional framework of the Wind River Mountains which might never have been obtained by conventional mapping techniques because of the vastness and difficulty of access to the area. The application to similar remote parts of the world both in pure geologic studies and in mineral exploration presents a very exciting prospect.

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