

## RETROGRADE CATACLASTIC GNEISS NORTH OF MOTAGUA FAULT ZONE, EAST-CENTRAL GUATEMALA

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### ABSTRACT

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An areally extensive quartz-monzonitic gneiss, characterized by a variety of cataclastic textures, has been mapped as the structurally lowest member of the Chuacus Group in east-central Guatemala. This apparent orthogneiss is separated from overlying Chuacus Group metasediments (phyllite and marble) by a south-dipping, low-angle thrust. The appearances of the gneiss is variable, ranging in texture from ultramylonite to blastomylonite gneiss.

Retrograde mineral assemblages characteristic of the upper-greenschist facies (quartz-microcline-oligoclase-biotite-chlorite) developed in response to cataclastic deformation adjacent to the Motagua fault zone, and do not represent regional metamorphism in the classic sense.

The areal extent of the gneiss suggests that it may be a fundamental basement unit north of the Motagua fault zone in Guatemala's Cordillera Central. It has not been recognized south of the fault zone.

### INTRODUCTION

Mapping of metamorphic rocks in the Rio Hondo Quadrangle, Guatemala, was undertaken in 1970 and 1971. Subdivision of metamorphic lithologies within the Chuacus Group revealed an areally extensive gneiss, the bulk chemistry, cataclastic texture, and metamorphic petrology of which distinguish it from structurally suprajacent metasediments. Its extensive distribution, and its unique lithologic characteristics, have not been previously described in detail, although Bosc (1971) recognized it in an adjacent area. The importance of this basement unit to an understanding of the geologic history of Nuclear Central America lies in the constraints its presence may impose on geological models.

### METHODS

Much of the Rio Hondo Quadrangle north of the Motagua

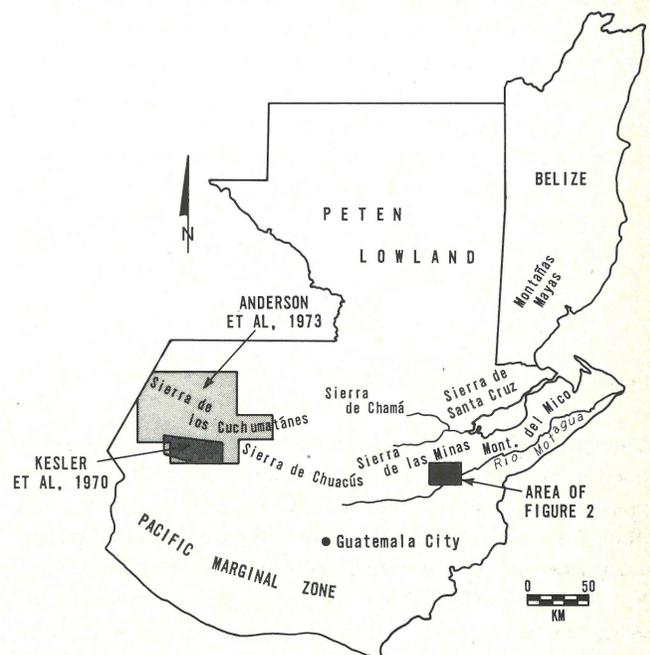


Fig. 1.  
Index map of Guatemala, showing area of Fig. 2, and map areas of Kesler et al. (1970) and Anderson et al. (1973).

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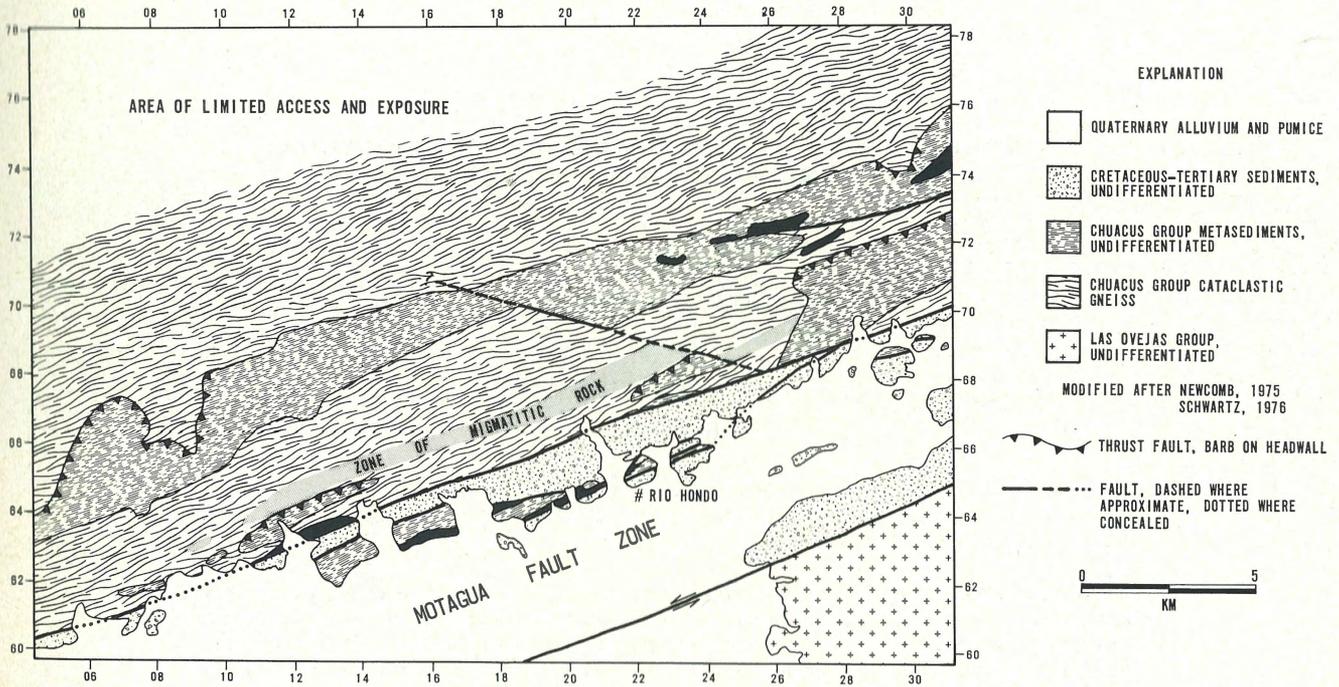


Fig. 2  
Generalized geologic map, Rio Hondo Quadrangle.

fault zone in east-central Guatemala was mapped on foot in 1970 and 1971 (Fig. 1). Subdivision of the Chuacus Group was among the goals of the study. Mapping and subsequent geochemical and petrologic investigations delineated an important lithologic unit which is widely exposed in this area and in adjacent portions of the Cordillera Central (Fig. 2). The unit is a cataclastic gneiss which varies in texture from ultramylonite to blastomylonite gneiss (terminology after HIGGINS, 1971). Eighty thin sections of this gneiss were examined in detail and thirty rock samples, chosen to represent the range of the unit's textural variation, were analyzed for major elements by rapid-analysis methods.

RESULTS

*Field appearance*

Immediately north of and adjacent to the Motagua fault zone, tan- or gray-weathering ultramylonites resembling slate or quartzite are exposed (Fig. 3G, 3H). Cataclastic foliation and lineation are the principal structures apparent in outcrop (Fig. 4). Examination of polished slabs and thin sections reveals that the ultramylonites contain sporadic minute porphyroclasts, breccia streaks, and rare, rootless isoclinal folds (Fig. 3C, 3F).

With increasing distance from the fault zone, the character of the gneiss changes, grading imperceptibly into mylonite,

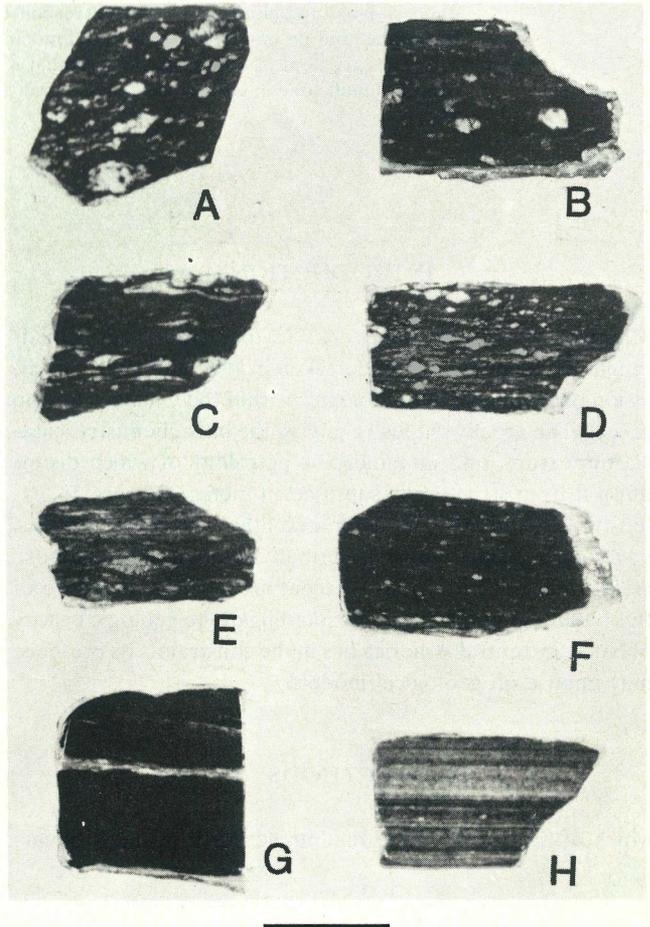


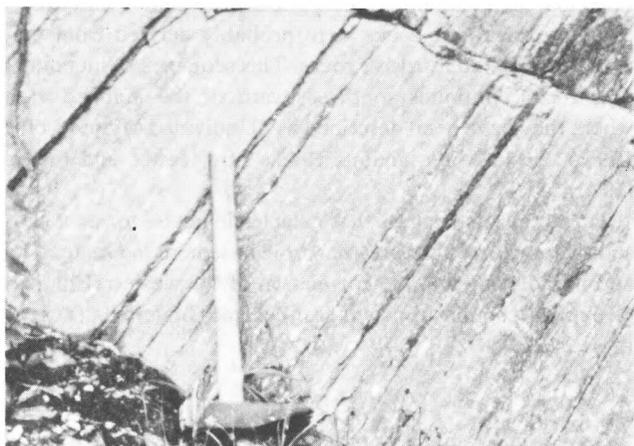
Fig. 3  
Representative cataclastic gneiss samples. Bar scale is 5 cm in length.



A



A



B



B

Fig. 4  
(A): Typical outcrop of cataclastic gneiss. Note prominent stretched porphyroclasts in plane of cataclastic foliation.  
(B): Cataclastic gneiss in cross section. Note prominent foliation. Stretching of porphyroclasts not evident.

Fig. 5  
(A): Close view of cataclastic gneiss, cross-sectional view.  
(B): Strongly lineated fabric in plane of cataclastic foliation.

protomylonite, mylonite gneiss, or blastomylonite (Fig. 3A, 3B, 3D, 3E). There are also tan- or gray-weathering lithologies, characterized by a strongly lineated fabric (Fig. 5A) and varying development of compositional layering, which results partly from tectonic elongation of mineral constituents. In cross-sectional exposures, the cataclastic lineation is less evident and the rock resembles an augen gneiss (Fig. 5B). Typical exposures of the gneiss lie along the roads near UTM coordinates 208655 and 265723 in the Rio Hondo Quadrangle (Fig. 2).

#### *Microscopic appearance*

The most striking microscopic characteristics of the cataclastic gneiss are sheared porphyroclasts and cataclastic foliation.

The cataclastic foliation is defined by alternating layers of quartzofeldspathic material, micaceous material, and/or finely comminuted, nearly isotropic material (Fig. 6A, 6B). The foliation wraps around tectonically deformed porphyroclasts which are dominantly microcline, but occasionally are aggregates of quartz and feldspar.

#### *Porphyroclasts*

Microcline, much of it perthite of the patch or string variety (SPRY, 1969), is the most common porphyroclast, the largest of which (up to 4.0 cm) are characterized by microcline twinning. Small grains, especially in the crush trails of large porphyroclasts, are untwinned and represent recrystallized pieces of the associated porphyroclast.

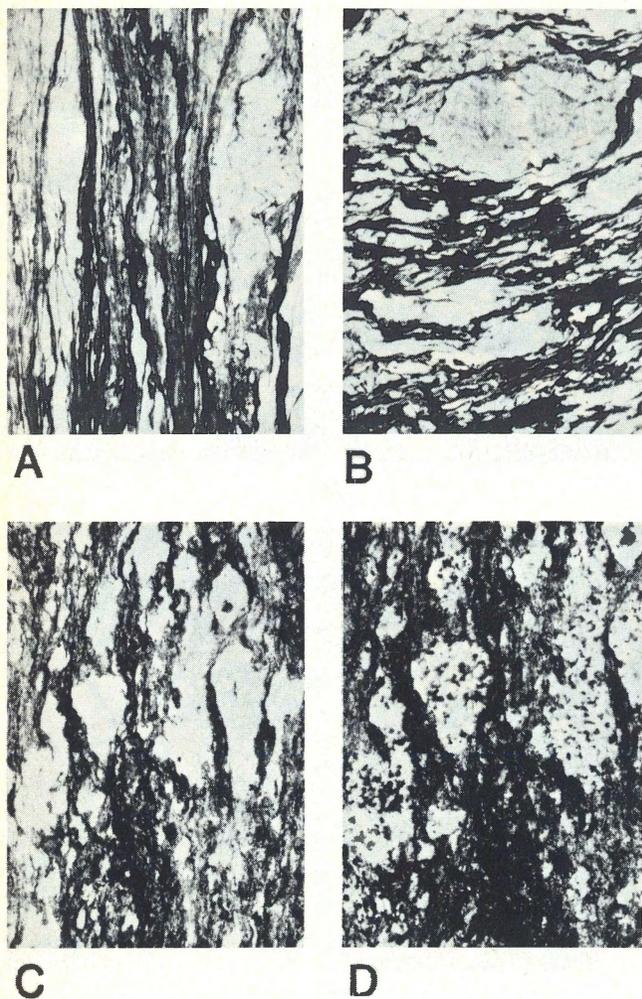


Fig. 6  
Photomicrographs of cataclastic gneiss.  
(A): Cataclastic foliation: note nearly isotropic material and elongate microcline porphyroclasts (plane light, 7x).  
(B): Cataclastic foliation and microcline porphyroclast (plane light, 7x).  
(C): Polygonized-Quartz porphyroclasts (plane light, 6.5x).  
(D): Same as (C) (crossed polars, 8.5x).

Quartz occurs in two distinct styles. The largest quartz crystals (0.5 cm) appear as bands or augen with lengths up to a few centimeters and widths of several millimeters. These crystals invariably show the effects of intense strain but are not recrystallized, as indicated by the strain shadows developed in them (Fig. 6C, 6D). Quartz also occurs as small polygonal grains which are unstrained, apparently products of recrystallization.

#### Chemistry

Chemical data indicate that the gneiss is quite homogeneous chemically, in spite of textural variations. Comparison of

thirty analyses of cataclastic gneiss with the granite system indicates that the gneiss is compositionally a quartz monzonite (Fig. 7A). The majority of the analyses lie in the vicinity of the thermal minimum in the system Q-Or-Ab-(H<sub>2</sub>O) as described by TUTTLE & BOWEN (1958) and within the field of 1190 granitic rocks determined by WINKLER & VON PLATTEN (1961; cited in WINKLER, 1967). Proximity of the gneiss' normative composition to the Q-Or-Ab thermal minimum suggests that the pre-cataclasis lithology was igneous (Fig. 7B).

#### Other occurrences

Cataclastic gneiss similar to that in east-central Guatemala is intimately associated with the Chuacus Group elsewhere in the country (Fig. 1). KESLER ET AL. (1970) and ANDERSON ET AL. (1973) reported similar rocks from northwestern Guatemala. Anderson *et al.* said of similar gneiss near Santa Barbara: '...these mylonitic rocks were probably derived from volcanic and related intrusive rocks. This sequence of metamorphic rocks continues south-eastward of the mapped area where they have been described as "Undivided Metamorphic Rocks" and "Meta-igneous Rocks" by Kesler and others (1970).'

These reports suggest that cataclastic gneiss forms a substantial portion of the pre-Mesozoic basement in Guatemala, and broadly support the correlation of the western Chuacus Group with similar rocks in east-central Guatemala (KESLER ET AL., 1970).

## METAMORPHISM

The most recent metamorphic event is associated with cataclasis resulting from movement within the Motagua fault zone. Metamorphic effects of this event are best seen in the cataclastic gneiss, although suprajacent metasediments have also been affected (NEWCOMB, 1974). The dominant assemblage (quartz-microcline-oligoclase-biotite-chlorite) is stable over a wide range of temperature-pressure conditions, and is referred to the upper-greenschist facies. Examination of eighty thin sections of this unit indicates that present metamorphic grade is due to dynamically induced retrograde metamorphism, rather than regional prograde metamorphism (NEWCOMB, 1975). This is an important point because some previous authors studying Chuacus Group lithologies have either dismissed cataclastic metamorphism as of minor importance in the larger geologic picture (MCBIRNEY, 1963) or have not mentioned its effects at all (KESLER ET AL. 1970). An exception is the work of ANDERSON ET AL. (1973), who recognized the role of cataclasis and retrograde metamorphism in the petrogenesis of cataclastic gneiss in northwestern Guatemala. Failure to recognize widespread retrograde metamorphism could lead to overlooking the earlier, regional metamorphism in constructing a realistic geologic history of the area.

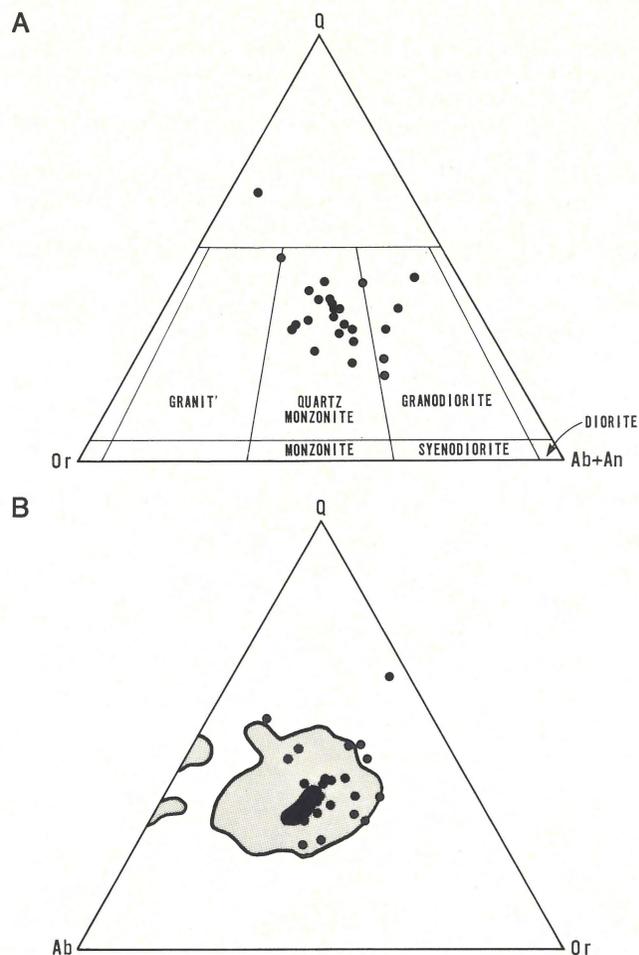


Fig. 7  
(A): Chemical classification of cataclastic gneiss based on calculated norms.  
(B): Q-Ab-Or-(H<sub>2</sub>O) system. Black area is thermal trough; gray area is field of 1190 analyzed granitic rocks from Winkler & Von Platten (1961).

## DISCUSSION

Cataclasis is the most pervasive geologic phenomenon recorded in the structural and metamorphic record of the Cordillera Central. Its imprint is sufficiently strong that, in many places, it is the only event preserved. For this reason, the author believes that much of the present metamorphic character of the Chuacus Group is not attributable to regional metamorphism in the classic sense, and that retrograde metamorphism is more important than has been previously reported. The ubiquitous occurrence of saussuritized plagioclase, chloritized biotite (and garnets), and severely altered hornblende, combined with rare, relict upper-amphibolite-grade assemblages (K-feldspar-biotite-fibrolite-garnet), indicates that extensive retrograde metamorphism accompanied cataclasis (NEWCOMB, 1975). Retrogression has been sufficiently widespread and

complete that much of the Chuacus Group reflects upper-greenschist-facies conditions, heretofore interpreted as a regional prograde metamorphism.

Areally extensive cataclastic gneiss in the Cordillera Central of Guatemala reflects continuing stress release along the Motagua fault zone and associated transcurrent faults in Nuclear Central America. It is probable that this basement unit has responded to fault tectonics of the area at least since the inception of transcurrent movement (?early Tertiary?) and possibly much longer. For this reason, future studies designed to examine the details of its metamorphic history may yield important data about the tectonics of the Motagua fault zone during a considerable portion of its history.

The structural position of the gneiss indicates that it may be the oldest unit of the Chuacus Group (?Paleozoic?) or an entirely separate, older unit (NEWCOMB, 1977). Its apparent igneous chemistry may suggest that the latter is more likely, although firmly established absolute dates of the unit are lacking. In either case, its cataclastic character, structural position, metamorphic history and chemistry distinguish it from adjacent units. Continuing refinement of structural, metamorphic, and stratigraphic relations of the old metamorphic rocks in Guatemala will improve our ability to understand the geotectonic development of Central America and the western Caribbean.

## ACKNOWLEDGEMENTS

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