

INTRODUCTION

The information presented on this sheet was collected as part of a joint U.S. Geological Survey-Geological Survey of Pakistan program sponsored by the U.S. Agency for International Development. As a project within this program, the coal-bearing Ghazij Formation (Eocene) was investigated in the northeastern part of Balochistan east and south of the provincial capital of Quetta. Strata exposed in this area range in age from Permian to Holocene and crop out as a belt of folded and thrust rocks that form a southeast-facing orocline. In this region of Pakistan, the Ghazij can usually be divided into three parts. The lower part is the thickest (probably more than 1,000 m) and consists of gray-weathering calcareous mudrock (shale, mudstone, and impure claystone) and a few tabular bodies of fine- to medium-grained calcareous sandstone. The middle part (27-300 m) consists of gray-weathering calcareous mudrock and tabular to lenticular bodies of fine- to medium-grained calcareous sandstone; beds of carbonaceous shale and coal are common (in the Mach area, the middle part of the formation also contains numerous individual beds of muddy limestone). The upper part (as thick as 533 m) contains reddish-weathering calcareous mudrock that contains scattered lenticular bodies of fine- to medium-grained calcareous sandstone. Fossil plant debris is common in mudrock of the lower and middle parts of the Ghazij and bivalves and gastropods are common in the middle part of the formation; the upper part of the Ghazij is usually unfossiliferous. Underlying the Ghazij are the carbonate rocks of the Paleocene Dungan Formation (or its equivalent), and overlying the Ghazij are the mostly carbonate rocks of the Eocene Kirthar Formation (or its equivalent). Both contacts can be conformable or unconformable. All of the pre-Neogene rocks in Balochistan are greatly deformed by the collision of India and the Arabian Plate. The Ghazij is especially susceptible to regional compressional tectonics because it contains large amounts of shale and is sandwiched between two thick carbonate units. As a result, bedding-plane faults and isoclinal folds are very common. As part of our study of the Ghazij Formation, five stratigraphic sections were measured: one near Pir Ismail Ziarat, one in the Sor Range, two in the vicinity of Mach, and one near the coast. Each area's section is published separately.

GISHTARI NALA STRATIGRAPHIC SECTION

In the fall of 1991, we measured our stratigraphic section north of Gishtari Nala, about 2.9 km west-southwest of the town of Mach, which is located about 48 km southeast of Quetta. At this location, the Ghazij Formation is well exposed and only slightly deformed. Although the lower part of the Ghazij Formation is recognizable in the Mach area, this part of the formation does not crop out in the vicinity of our section. Our section probably contains some of the middle and upper parts of the Ghazij, but placing a contact between these two subdivisions is problematic. Carbonaceous shale and fossils are present throughout the section, and these are usually not associated with the upper part of the Ghazij. This suggests that the section might contain only the middle part of the formation. However, mudrock in the upper part of our section contains units of impure claystone, a lithology commonly associated with the upper part of the Ghazij. Based on this criteria, a line separating the middle and upper parts of the Ghazij was placed at about 241.5 m. Mudrock in our section weathers light yellowish or light brownish gray and contains abundant fossil plant debris. Sandstone contains subangular to subrounded grains of quartz, light-colored carbonate rock fragments, and green lithic fragments. The sandstone is light gray and weathers light yellowish gray. Muddy limestone (or, in some cases, perhaps limy mudrock) usually forms a single thin bed and is commonly very fossiliferous. The rock is grayish brown and weathers orange. Fossil bivalves, especially oysters, high-spiral gastropods, and ostracodes are locally abundant stratigraphically above 103.5 m. Coal is being mined in the vicinity of this section from the Gishtari coal bed and from the coal bed between 268 and 269 m. The carbonaceous shales at 256, 280, and 298 m locally grade into coal along strike, and some mining activity is evident. In contrast to the middle part of the Ghazij measured near the Mughal mine, 3.8 km to the southeast, the middle part of the Ghazij at Gishtari Nala contains more oysters, more sandstone bodies, and fewer limestone beds. In the Gishtari Nala area, a Quaternary age conglomeratic unit rests unconformably on the eroded top of the Ghazij and consists of well-rounded pebbles and cobbles of gray limestone.

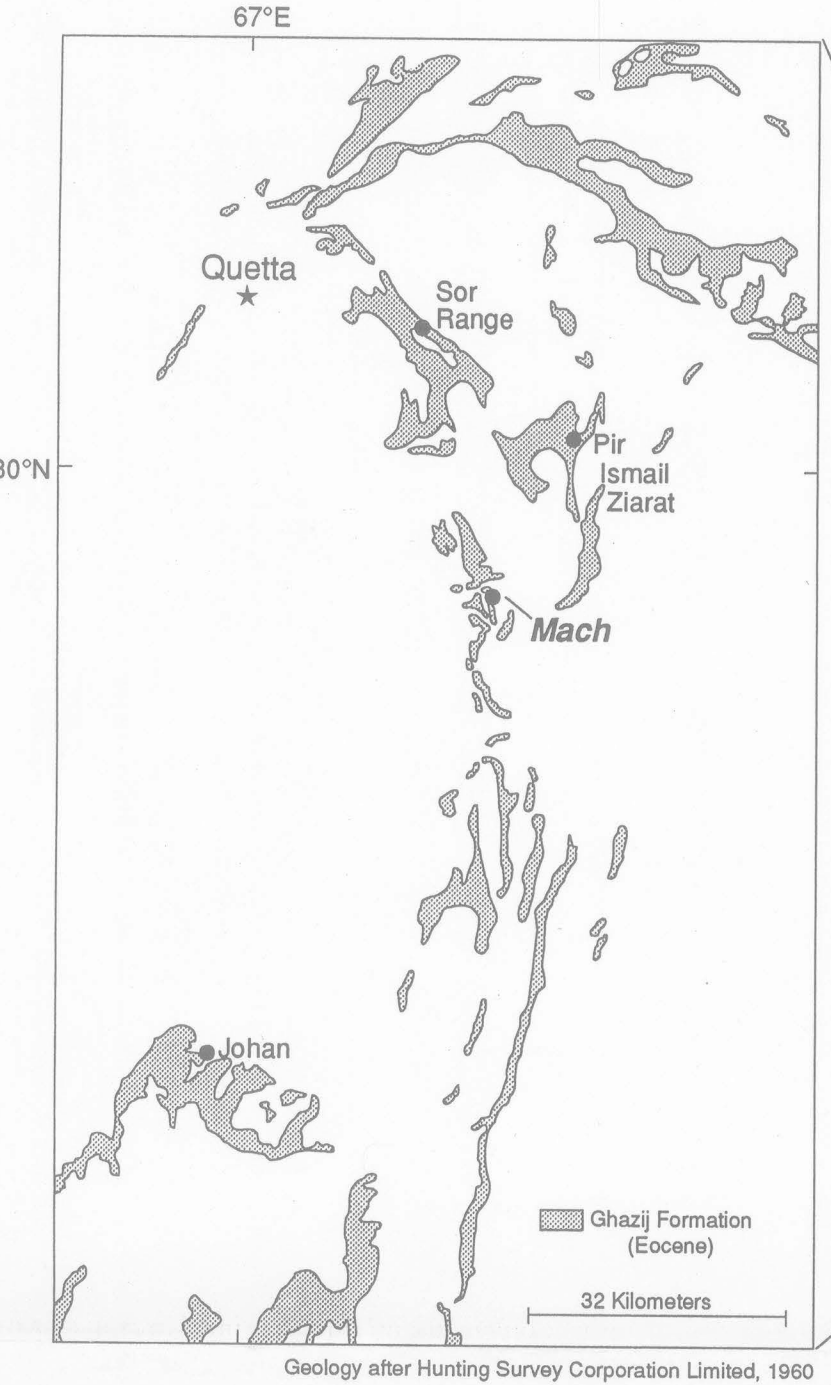
The scaled horizontal line at the base of the stratigraphic columnar section (grain size generally increasing to the right) is a crude erosional profile. Mudrock (mudrk) includes shale, mudstone, and impure claystone. Sandstone is very fine grained (vfg), fine grained (fg), medium grained (mg), coarse grained (cg), and very coarse grained (vcg). Other abbreviations are "carb sh" for carbonaceous shale, "clayst" for claystone, "siltst" for siltstone, "cong" for conglomerate, "lss" for limestone, and "ls" for limestone. Some of the lithologies shown on the horizontal scale might not be present in the columnar section because they are not present along the line of section. Samples collected along the section for future reference are indicated by letter-number annotations to the left of the column. Contacts between similar lithologies indicate change in grain size, color, or sedimentary or biogenic structures. Those parts of the section that lack data represent covered intervals.

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EXPLANATION

- Sandstone
- Siltstone
- Mudrock (shale, mudstone, or impure claystone)
- Carbonaceous shale
- Coal
- Muddy limestone
- Conglomerate



PRINCIPAL REFERENCE SECTION FOR PART OF THE EOCENE GHAZIJ FORMATION, GISHTARI NALA AREA, MACH COAL FIELD, BALOCHISTAN, PAKISTAN

By

Peter D. Warwick,¹ Edward A. Johnson,¹ Intizar H. Khan,² and Mohsin A. Kazim²

¹ U.S. Geological Survey

² Geological Survey of Pakistan