A Previously Undescribed Meteorite Crater in Chile[1]

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A previously undescribed meteorite crater having dimensions of 455 m average diameter and 31 m average depth has been discovered in northern Chile at 23°55.6'S, 68°16.7'W. Meteorites have not been recovered, but iron shale and impactite material verify its meteoritic origin. The crater is emplaced in granite, overlain by a thin ignimbrite sheet. From the apparent disruption of the local Pleistocene drainage pattern, the age of formation of the crater must be Pleistocene or Recent. It may have been formed by the same meteoroid that created the Campo del Cielo craters in Argentina. The name Monturaqui crater is proposed.

INTRODUCTION

A cooperative program has been established between the Chilean Instituto de Investigaciónes Geológicas and Lamont Geological Observatory of Columbia University for field studies on meteorites and meteorite craters. During November 1965, we visited a crater-like feature that had been located on aerial photographs by Sanchez 3 years earlier. At that time he had noted that the crater did not appear to be volcanic, and he conjectured that it might be a meteorite crater. During our visit we collected meteoritic iron shale and impact (?) glass on the rim crest and flanks of the crater, thus verifying Sanchez's speculations.

LOCATION AND DESCRIPTION

The crater is located in the precordilleran ranges south of the Salar de Atacama at 23°55.6'S, 68°16.7'W (Figure 1). It is emplaced in Jurassic granite that locally is cut by centimeters-wide dikes of phaneritic texture and probably basic composition. The ancient erosion surface of the granite is overlain unconformably by Upper Tertiary or Pleistocene ignimbrite. The crater lies near the edge of this sheet, in a zone where earlier topographic depressions still contain a 4- to 5-m thickness of ignimbrite but where previous granite prominences are once again exposed. Both granite and ignimbrite crop out in the walls and rim crest of the crater, but the rim crest is almost completely mantled with ignimbrite.

Small-scale stratification is not obvious in the ignimbrite layer, but a prominent fracture or jointing plane, visible at scattered points in the rim, slopes radially outward (Figure 2), suggesting uplift. From the aerial photograph (Figure 3) it seems probable that the sudden formation of the crater cut off pre-existing drainage gullies and forced the upstream segments into a new pattern around the flanks of the crater; therefore, we assign the formation of the crater to a time after a drainage system had developed in the Upper Tertiary-to-Pleistocene ignimbrites.

The diameter of the crater is 470 m E-W × 440 m N-S. The wall height is very variable, ranging from 16 to 48 m above the low point. The variable wall height was probably caused by topographic irregularities in the pre-impact surface. The low point, seen in the aerial photograph as a white spot of fine clay and silt, is off-center toward the northeast; thus the crater is somewhat asymmetric.

METEORITIC MATERIALS AND IMPACT PRODUCTS

Material like that shown in Figure 4 was

[1] Lamont Geological Observatory Contribution 944.

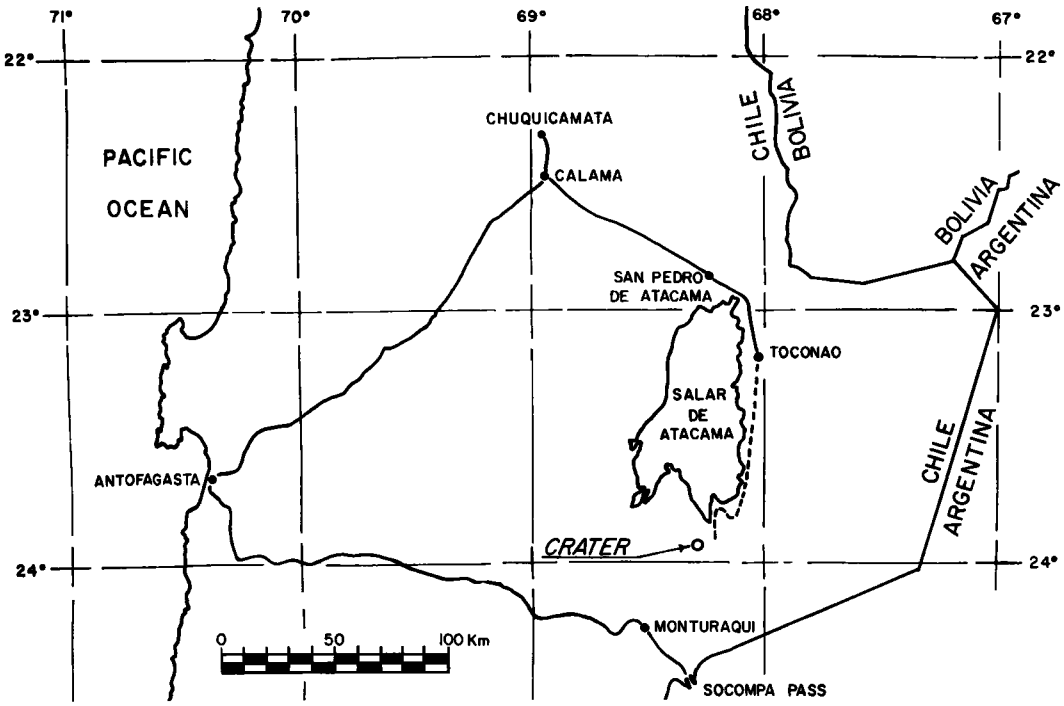

Fig. 1. Map of part of Chile showing location of the crater, just south of the Salar de Atacama. The Salar is one of a number of evaporite plans found commonly in the Atacama Desert and the High Cordillera of northern Chile.

Fig. 2. Photograph of ignimbrite blocks at the rim crest of the crater. They appear to be tilted up toward the right. Center of the crater is to the right.

Fig. 3. Aerial photograph of the crater. North is at the top. The feature is approximately 450 m in diameter. The white spot inside the crater is fine clay and silt accumulated at the low point. Note the two drainage gullies approaching the crater from the south; they have apparently been diverted by the rim flanks of the crater. Short gullies now draining the northeast rim flank were probably their downstream continuations before formation of the crater.

found at points on the north and southwest rim and south flank of the crater, and it is undoubtedly a meteoritic iron shale. The iron shale is magnetic. The specimens shown in Figure 5, found in great abundance on the south and southeast flanks of the crater, are probably impactites. These consist of porous cindery aggregates containing fragments of granite and are bonded with glass. Many of them are weakly magnetic, which suggests that they contain metallic iron. Specimens as large as first size were found. No meteorites were found on the surface, but this is not surprising because a llama trail crosses the outer flank of the crater; all specimens originally lying on the surface could have been picked up by passing herdsmen and traders. This llama trail is a historically important route running from the Pacific coast through Monturaqui to San Pedro de Atacama and finally across the cordillera into northern Argentina [*Fletcher*, 1889]. It is conceivable, therefore, that many of the iron meteorites reported from other localities in Chile were originally found at this crater. For this reason it will be of great interest to recover a meteorite specimen from the crater site.

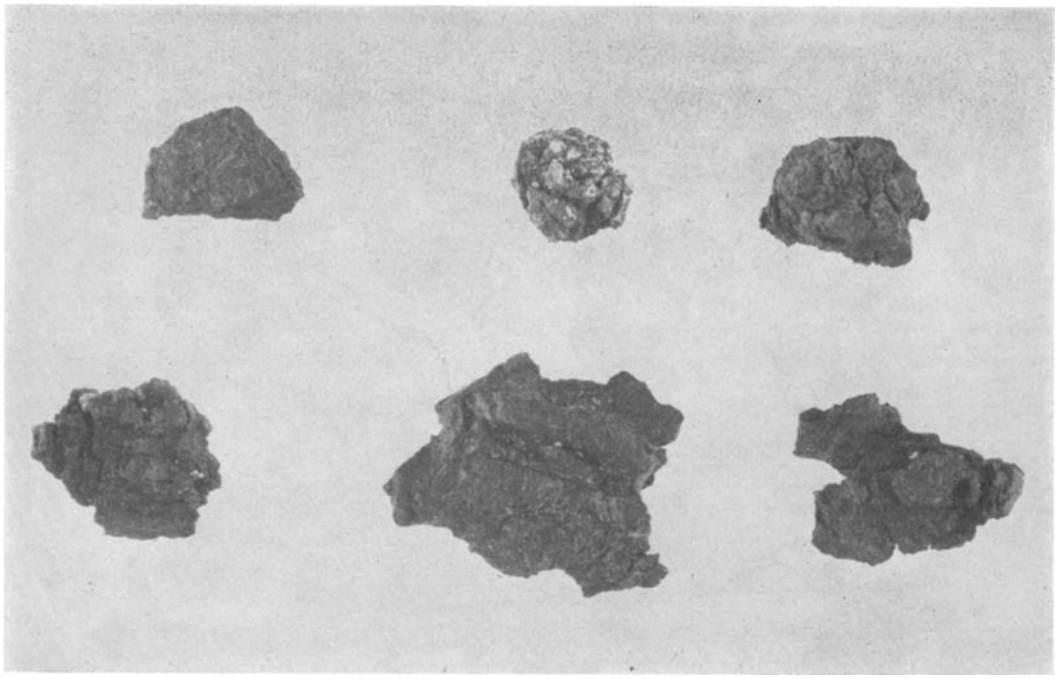

Fig. 4. Meteoritic iron shale found on the rim and flanks of the crater. The largest specimen is 5 cm across.

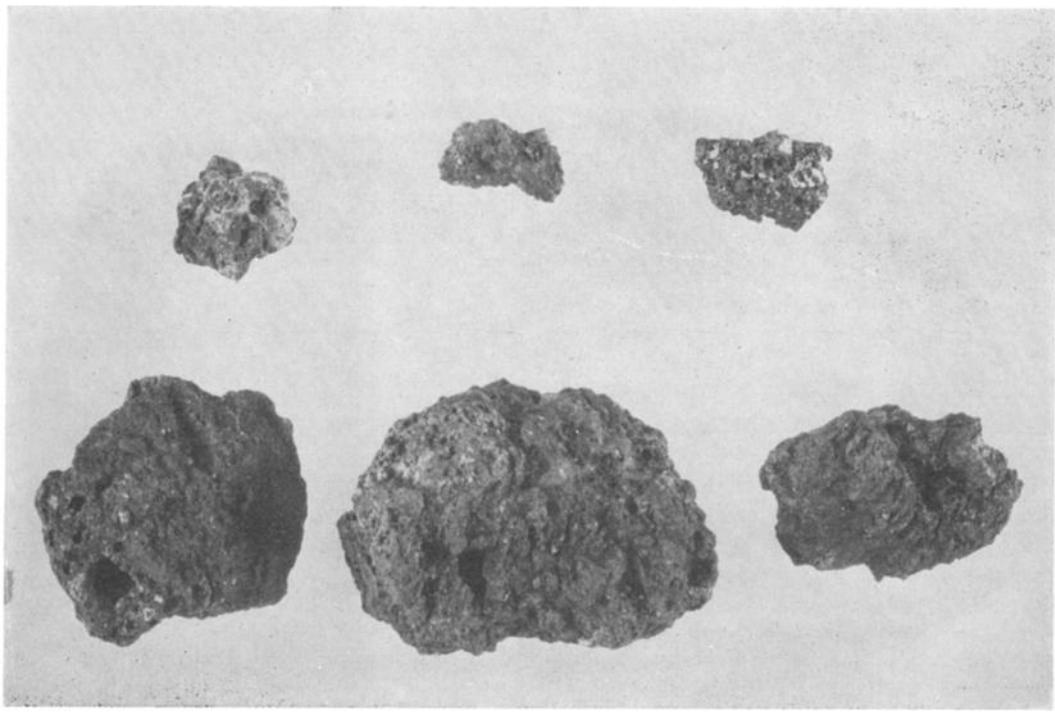

Fig. 5. Impact(?) glass found on the rim and flanks of the crater. The cindery aggregates differ in color and texture from pumiceous and slaggy volcanic bombs of the region. They are found associated with the crater only. The largest specimen is 7 cm across.

Discussion

Large features that appear to be impact craters in the granitic shield areas of Canada have been described [*Innes*, 1964; *Dence*, 1965]. Because this crater was emplaced in granite, its geological relations and impact products are expected to be more than normally interesting. It is possible, too, that details of its structure may be more directly comparable with those of the Canadian craters, and of lunar craters, than with those of other terrestrial meteorite craters that have been formed in sediments.

The present cooperative research program between Lamont Geological Observatory and the Instituto de Investigaciónes Geológicas was set up as the result of findings by *Cassidy et al.* [1965], who suggested the possibility of the existence in northern Chile of one or more meteorite craters formed by the fall of meteorites that had survived a previous orbital perigee pass over Campo del Cielo in northern Argentina. A line of meteorite craters bearing along azimuth 60° exists at Campo del Cielo, and we believe that a large parent meteoroid in a terrestrial orbit of minimum size could have supplied the fragments that formed these craters and still have survived to make one or more additional passes through the atmosphere during succeeding orbits. Minimum orbits of the earth have a period of about 90 min (shorter ones would be deep in the atmosphere or below the earth's surface); therefore the suggested second perigee pass would have been made along azimuth 60° but at least 22° west of Campo del Cielo (since the earth rotates 22½° in 90 min).

The crater reported here is only 14° west of Campo del Cielo, and according to previous speculations there is no reason to believe the two are related. They could be related, however, if the meteoroid that caused the Campo del Cielo crater field had a 25-hour period, and this possibility is being investigated. Supporting evidence would be additional craters arranged along azimuth 60°, close similarity of meteoritic material from the two sites, and equal ages of formation of the two occurrences.

Nomenclature

The town nearest to the crater is the village of Peine, some 35 km to the northeast. The next closest town is Monturaqui, approximately 70 km to the south. Because Monturaqui is better known and the crater is located in the northern extension of the Monturaqui mountain range, we propose that the crater be called the Monturaqui crater.

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