# A new analysis of Monturaqui Meteorites

**Stanislav Kaniansky[1] and Kristian Molnár[2]**

[1] **Maximilian Hell District Observatory and Planetarium in Žiar nad Hronom,**

**organizational part Observatory Banská Bystrica, Slovak Republic**
sky@planetarium.sk

[2] **UMa Astronomy, Blahová, Slovak Republic**
krmolnar76@gmail.com

The Monturaqui meteorite crater, located in the Andes Mountains, is known to host corroded iron meteorites (Koch and Buchwald, 1994), of probable IAB type. Over three hundred suspicious rocks with an exterior appearance were collected during the two expeditions to Monturaqui crater. A sample has been analyzed in the Department of Earth and Atmospheric Sciences, University of Alberta, Canada. The analyses support the conclusion that the Monturaqui rocks are corroded iron meteorites.

## 1 Introduction

The Monturaqui is one of the most impressive meteorite craters in the World. It is located south of the Salar de Atacama in the Antofagasta Region, Atacama Desert in Chile. The site is located approximately 3000 m above the sea level. The crater is exposed at the surface and is 350 x 370 m (1150 x 1210 ft) in diameter and approximately 34 m (112 ft) deep. This crater was created 633000 ± 90 years ago, during the Pleistocene Epoch by a meteorite coming from the north-west.

It was first described in scientific literature in 1966 (Sanchez and Cassidy, 1966) – then it got its name too. The meteorite hit a thin layer of volcanic rock – 3.2 million years (Pliocene) old ignimbrites. It penetrated it and smashed granite under it as well. As the meteorite was falling askew, the crater is elongated in northwest – southeast direction, the steepest edge (35 degrees steep) is in the south-east. Also the rim of the crater in the south is 10 – 15 m higher than in the north.

In the vicinities of the crater and inside it many corroded fragments of impact melt rocks with extreme magnetism have been found. The size ranged from a few millimeters to centimeters.

## 2 Analysis

Over three hundred suspicious rocks with an exterior appearance were collected during two Slovak expeditions to Monturaqui crater. One sample was sent for analysis to the Department of Earth and Atmospheric Sciences, University of Alberta, Canada. The analysis has been provided by Dr. Christopher Herd.

A 0.445 g powdered subsample was submitted to the ICP-MS lab for dissolution and multi-element analysis. A sample of the North Chile hexahedrite iron meteorite (syn: Filomena), found 150 km NW from Monturaqui was analyzed in parallel in the same session.

## 3 Results

The results strongly indicate that the sample is indeed a corroded iron meteorite. This conclusion is based on the following results of the analyses (*Table 1*).

*Table 1* – Results of the analyses indicating the sample is a corroded iron meteorite.

| Analyte | Cr | Co | Ni60 | Ni62 | Cu | Ga | As | Ru |
|---|---|---|---|---|---|---|---|---|
| Units | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* |
| Filomena | 32.34 | 3524.32 | 41932.06 | 46362.88 | 103.83 | 56.14 | 7.53 | 15.09 |
| Monturaqui | 13.08 | 2018.12 | 25419.65 | 28443.41 | 65.54 | 46.95 | 159.43 | 3.34 |

| Analyte | Rh | Pd | W | Re | Os | Ir | Pt | Au |
|---|---|---|---|---|---|---|---|---|
| Units | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* |
| Filomena | 1.02 | 1.86 | 2.76 | 0.21 | 0.17 | 3.31 | 23.43 | 0.15 |
| Monturaqui | 0.36 | 1.06 | 7.71 | 0.08 | 0.02 | 0.75 | 2.55 | 0.08 |

1. The concentrations reported for Ni and Co (2.7 wt% and 0.2 wt%, respectively) are consistent with the values reported by Koch and Buchwald, 1994: 3.1 wt% Ni and 0.4 wt% (converting from oxide to element).

2. The absolute concentrations in the Monturaqui sample are all approximately 30-50% of the concentrations in IAB meteorites. This result indicates that all distinguishing elements found with iron meteorites have been diluted to a similar extent by alteration.

3. The key ratios that distinguish IAB meteorites, namely Ni/Ir and Ni/Ga, are the same in the Monturaqui sample as they are in IAB meteorites. This is consistent with alteration affecting the absolute concentrations, but not relative ratios.

## References

Koch C. and Buchwald V. F. (1994). "Weathering of Iron Meteorites from Monturaqui, Chile". *Meteoritics*, **29**, 443.

Sanchez J. and Cassidy W. (1966). "A previously undescribed meteorite crater in Chile". *Journal of Geophysical Research*, **71**, 4891–4895.

The author *Stanislav Kaniansky* (middle) at the arrival in Mistelbach together with *Matej Korec* (right) and *Juraj Škvarka (left)* (Photo by *Axel Haas*).