

Geoglyphs of Titicaca

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Geoglyphs of Titicaca

Amelia Carolina Sparavigna



Torino, Italy, 2010

This book is dedicated to my grandmother, Carolina Dastrù.

Amelia Carolina Sparavigna is assistant professor from 1993 at the Polytechnic of Torino, Italy. She gained her Bachelor Degree in Physics from the University of Torino in 1982, and the Doctoral Degree in 1990. She is co-author of more than 80 publications on international journals. Her research activity is on subjects of the condensed matter physics, liquid crystal microscopy and image processing. She has a passion for archaeology.

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Geoglyphs of Titicaca

Amelia Carolina Sparavigna

A network of ancient earthworks covers a large part of the land near the Titicaca Lake. The slopes of hills are criss-crossed with terrace walls and the surfaces of the plains covered with raised fields, indicating that this was once a highly productive agricultural place for the south central Andes. Using the Google Maps satellite imagery, we discover that some landforms are geoglyphs, with a clear symbolic function. Among them, there are animals, where ponds are their eyes.

Any landform composed of fine-grained materials evolves in wide and flat relieves, due to the down-slope transport of its materials over time. Earthworks, which are artificial landforms, are subjected to the same destiny, to be widened and flattened as a consequence of the natural degradation processes¹. Sometimes, men are enhancing their degradation.

Due to evolution, ancient earthworks become sinusoidal profiles apparent on the current landscape. Therefore, these ancient structures become in the satellite imagery a texture superimposed to the background landform. In some cases, in spite of natural degradation and human actions, these textures remain quite visible. A wonderful example is the really huge network of earthworks, covering a total of 120,000 hectares of the land near the Titicaca Lake.

These earthworks are the result of an almost unimaginable agricultural effort of ancient Andean people. Some of the landforms are rather remarkable, having a clear symbolic meaning, being then geoglyphs. Some represent birds, where circular ponds are their eyes. Other animals can be observed in a complete survey of the lands near the lake.

Earthworks, canals and ponds are the remains of an extensive ancient agricultural system built and used by Andean peoples centuries ago, throughout the vast high plain surrounding Titicaca Lake. People created a system of raised fields, which were large elevated planting platforms, with the corresponding drainage canals and ponds. This system improved soil conditions, the temperature and moisture conditions for crops. These remains are then providing evidence of the impressive engineering abilities of the peoples who lived there in pre-Columbian times. Moreover, this finding contradicts the opinion that considers the lands of the Lake Titicaca to be unproductive agriculturally. Archaeology and the satellite imagery, demonstrate the past richness of the area,

¹ Being erosion acting on earthworks, as on all landforms, the study of those structures with known age and initial morphology is particularly interesting for geophysical researches. Comparing the original with the current shape provides the data for developing and testing models for long-term landform erosion. Such investigation was applied, for instance, to the Inca agricultural terraces abandoned at 1532 A.D. in the dry lands of southern Peru, see for instance, Pattern and rate of erosion inferred from Inca agricultural terraces in arid southern Peru, Ana C. Londoño, *Geomorphology*, Volume 99, Issues 1-4, 1 July 2008, Pages 13-25; Modeling the natural degradation of earthworks, M.A. O'Neal, M.E. O'Mansky, J.A. MacGregor, *Geoarchaeology*, Volume 20, Issue 7, October 2005, Pages 739-748

due to this vast complex of agricultural earthworks.

The local farmers call the artificial landforms "waru waru" or "camellones" (pre-Hispanic raised fields are present in other regions too²). The local farmers of Titicaca had no idea that these textures are the persisting evidence of remarkable skills of their ancestors, until 1981, when Clark Erickson, University of Illinois, recognized the significance of waru waru. He and other researchers started an experimental reintroduction of raised fields, in the Huatta, a land near the lake, in Peru. They persuaded some local farmers to rebuild a few of the raised fields, plant them in indigenous crops, and farm in traditional manner. Archaeological and experimental data suggest that raised fields might be more appropriate for the region³.

Let us observe the satellite images. Lake Titicaca sits 3,811 m above sea level, in a basin high in the Andes on the border of Peru and Bolivia. The western part of the lake lies within the Puno Region of Peru, and the eastern side is located in the Bolivian La Paz Department. Both regions have the slopes of the hills criss-crossed with terrace walls. Some parts of the plain surfaces are covered with raised fields, indicating that this was once a highly productive agricultural place for the south central Andes.

As earthworks, raised fields are constructed by excavating parallel canals and piling the earth between them creating long and low mounds, surfaces being flat or convex. These raised platforms created a local micro-environment, able to reduce the frost risk for crops. The canals between raised fields act as sources of moisture during the periods of drought. Moreover, water in the deep canals and in ponds might have been used to cultivate aquatic plants and fish, as well as attract lake birds⁴. The raised fields of Titicaca have different forms and size, generally being 4-10 m wide, 10 to 100 m long, and 1 m tall. At a later time, the wavelength increased for larger fields to 10 m.

In spite of erosion, the network of these not so-high earthworks is clearly visible from the space. This book shows a collection on images from the Google Maps imagery, enhanced with image processing tools⁵. We can see many textures having a clear symbolic evident planning: these artificially landforms are then geoglyphs. Moreover, we can suggest a rule of thumb: to find the geoglyphs, look for circular ponds, because sometimes they can be the eye of an animal.

Many geoglyphs are in Peru. In Bolivia we find a large area (located approximately at coordinates -16.427,-68.582) where the raised fields have a different style⁶. Here too, we see beautiful landforms, showing snakes, birds and other objects, not so easy to figure out.

Let us then start our survey of the geoglyphs of Titicaca. Coordinates are reported in the figures.

² Pre-Columbian earthworks in coastal Amazonia, S. Rostain, *Diversity*, Volume 2, 2010, Pages 331-352; Pre-Hispanic Raised Field Agriculture, C. Erickson, web page, <http://www.sas.upenn.edu/~cerickso/>; Agricultural Earthworks on the French Guiana Coast, S. Rostain, *The Handbook of South-American archaeology*, Volume 3, 2008, Pages 217-233

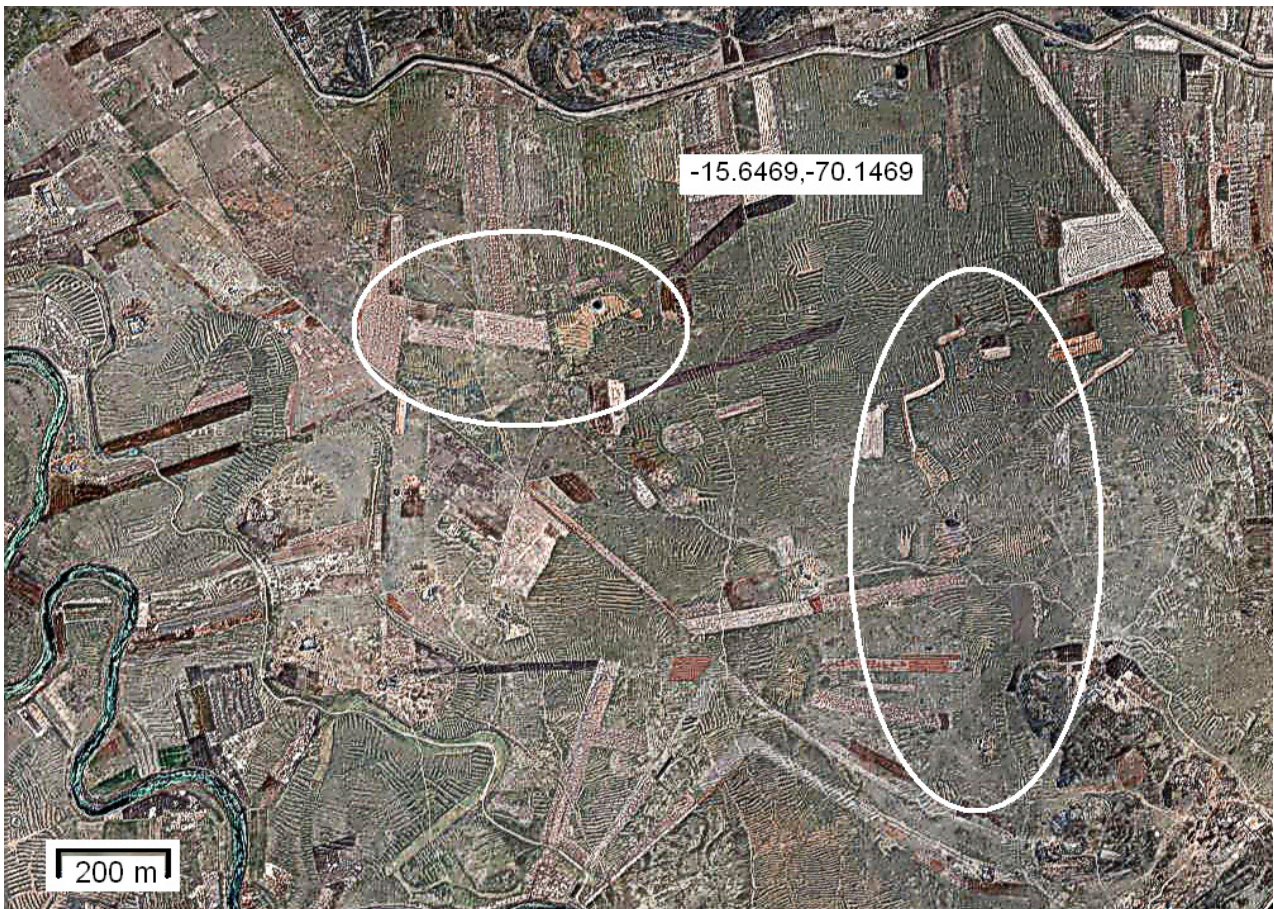
³ Raised field agriculture in the Lake Titicaca basin, C.L. Erickson, *Expedition*, Volume 30(1), 1988, Pages 8-16

⁴ Idem

⁵ To have an idea of the processing procedure used for the images shown in this book, the reader can see the paper entitled, Enhancing the Google imagery using a wavelet filter, A.C. Sparavigna, 8 Sept 2010. *Geophysics* (physics.geo-ph); *Earth and Planetary Astrophysics* (astro-ph.EP), arXiv:1009.1590

⁶ The Bolivian geoglyphs were discussed in a post of February 24, 2008, by David E. Flynn, post with a surprising title: Discovery of vast prehistoric works built by Giants? The Geoglyphs of Teohuanaco; see also the page by J.M.Allen, 5th Nov 2009, <http://www.atlantisbolivia.org/geoforms.htm>

Peru



Here we see a plain region quite interesting. Two areas are pointed out that we shall observe in detail in the two following images.



This is the head of a bird, where a circular pond is the eye.

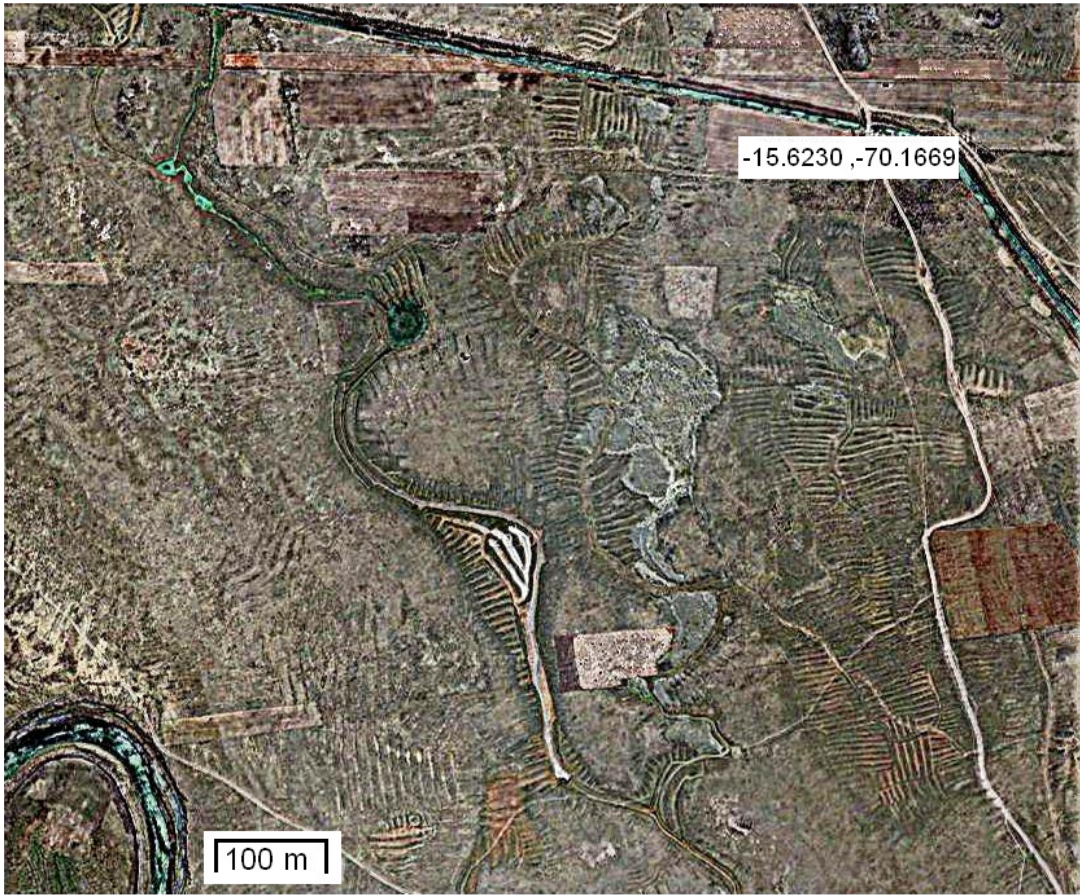


An ant-bear?

Peru



**Here we see a canal and the beak and claw of a bird at two bends of it.
Note that here we have two geoglyphs, that we see in the following two images in detail.**



Peru



A hedgehog (originally upside-down).

Peru



A snake, with the body and texture of skin created by the terraced hill (left part of the image), the head (darker area) on the plain surface of the ground, a pond as its eye. Note the bifid tongue.

Peru



The detail of the head.

Peru



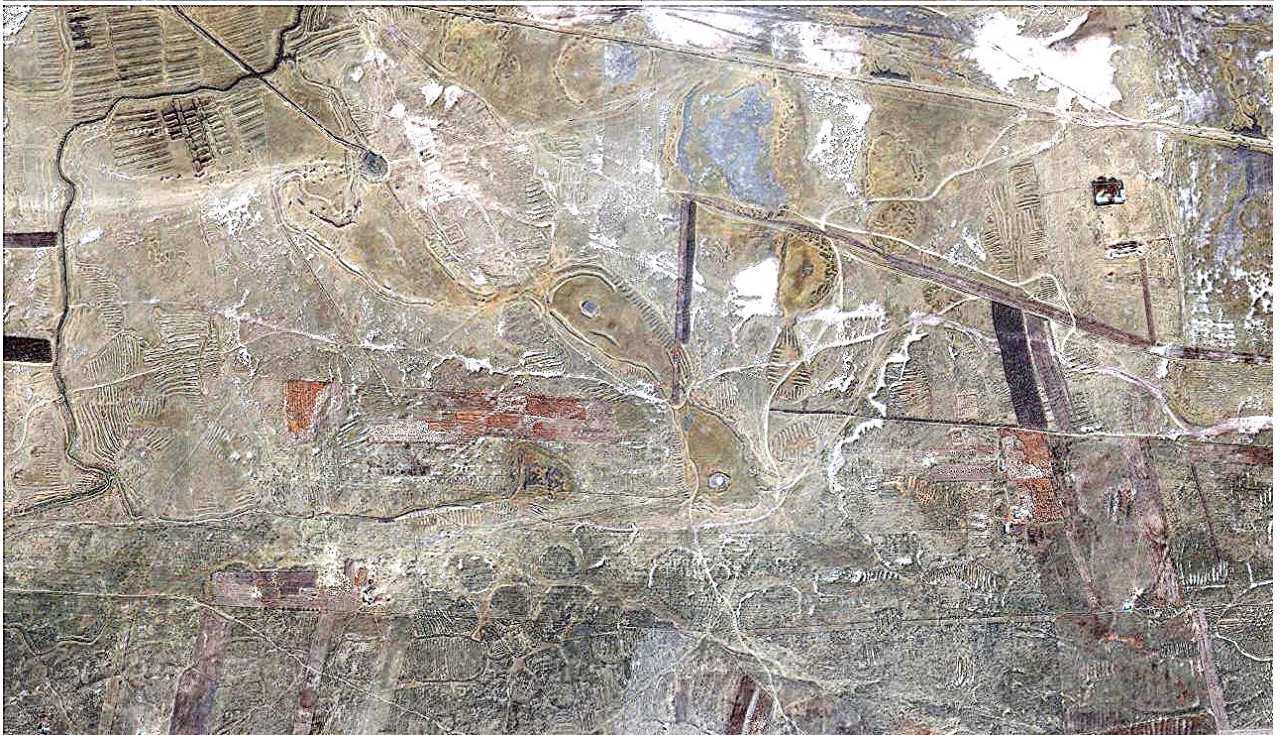
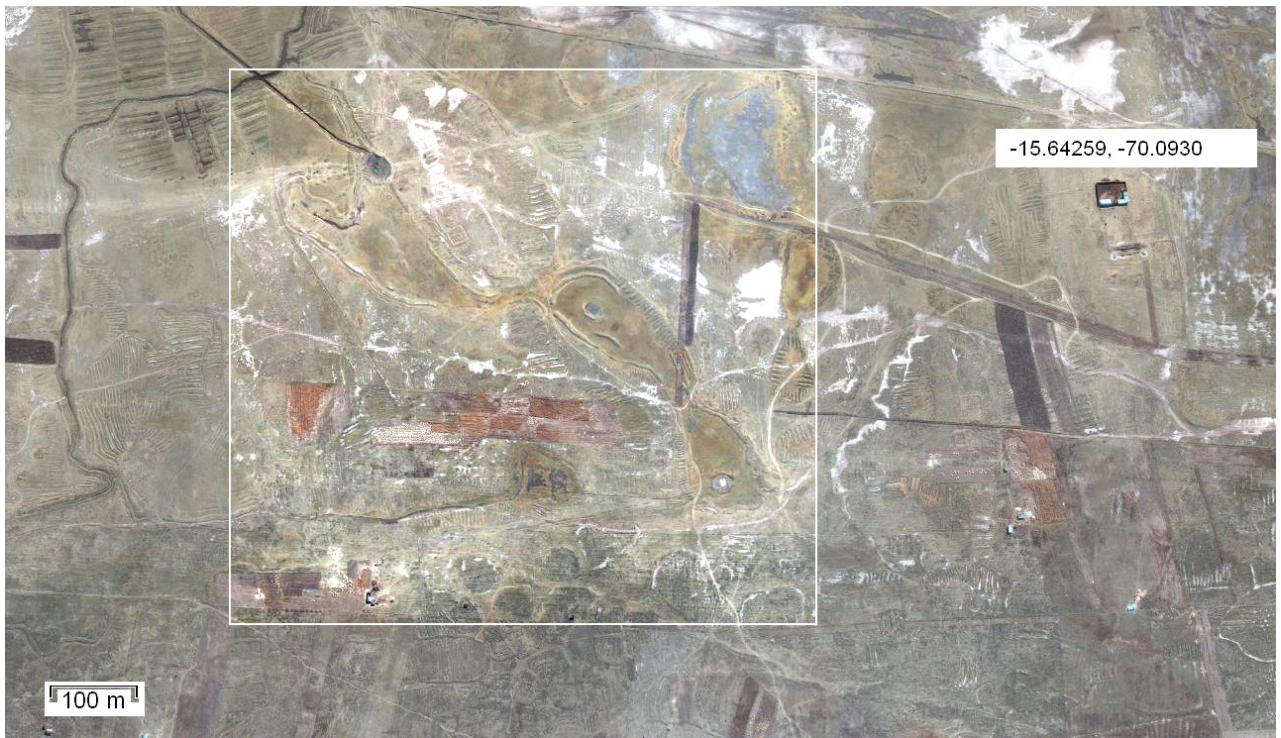
The snake is not alone. It is an element of a more complex drawing, with another animal, which seems assailing the snake.

Peru

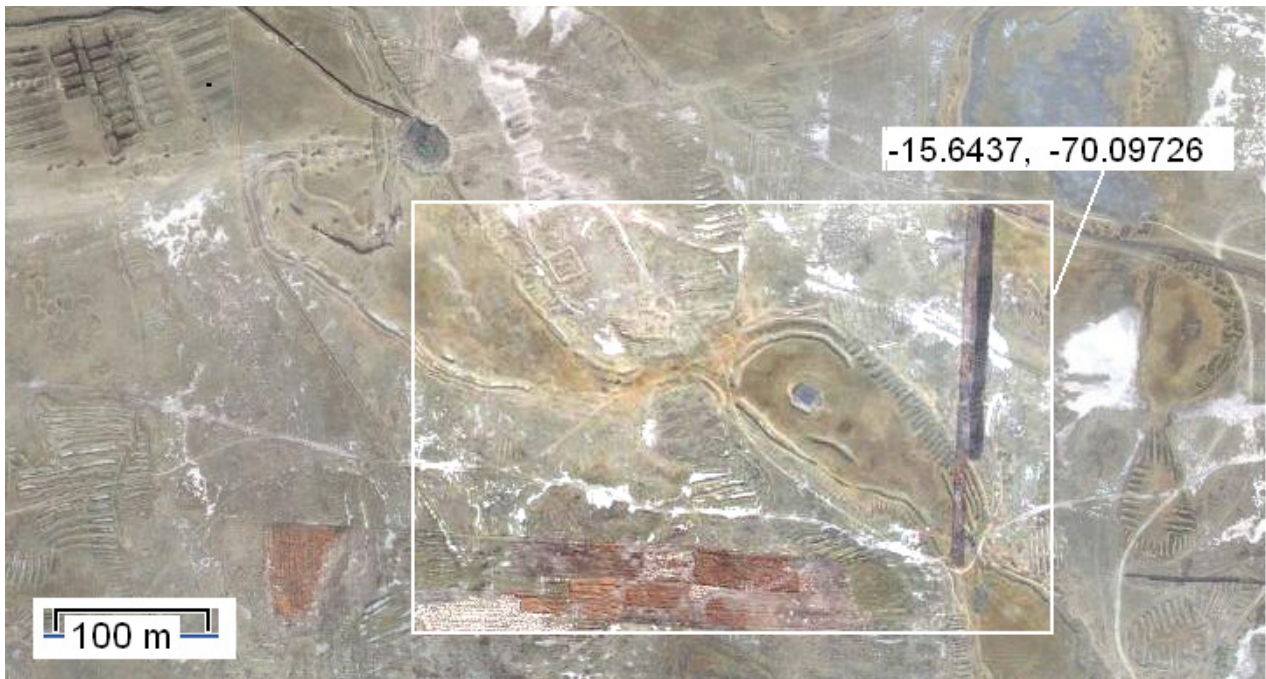


Sometimes, a geoglyph is beautiful and well preserved but difficult to identify (a fish?, a tortoise?).

Peru



Another interesting plain area.



Is this landform representing a condor?



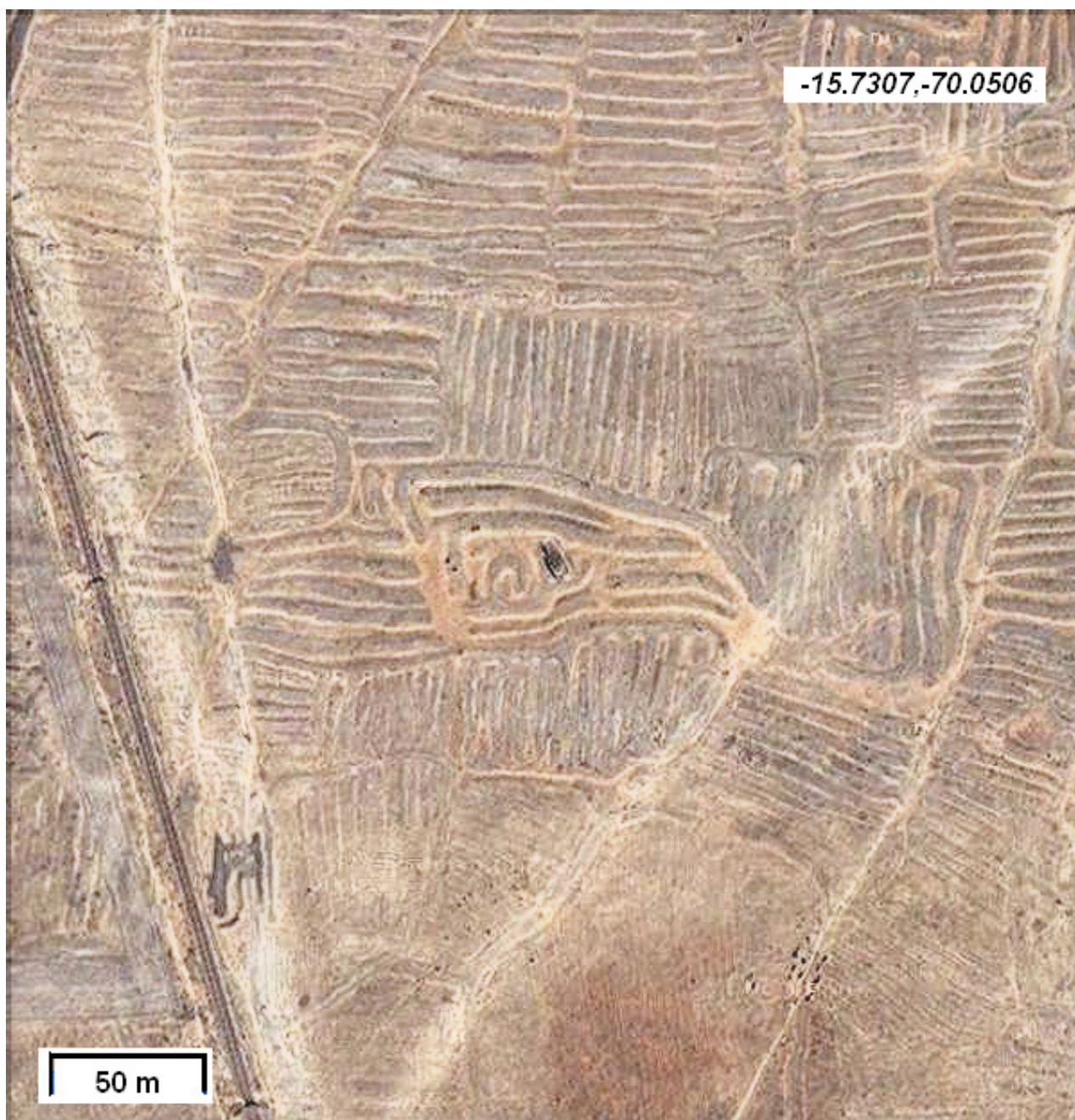
This is the destiny of ancient earthworks, cancelled by time, modern cultivations and roads.

Peru



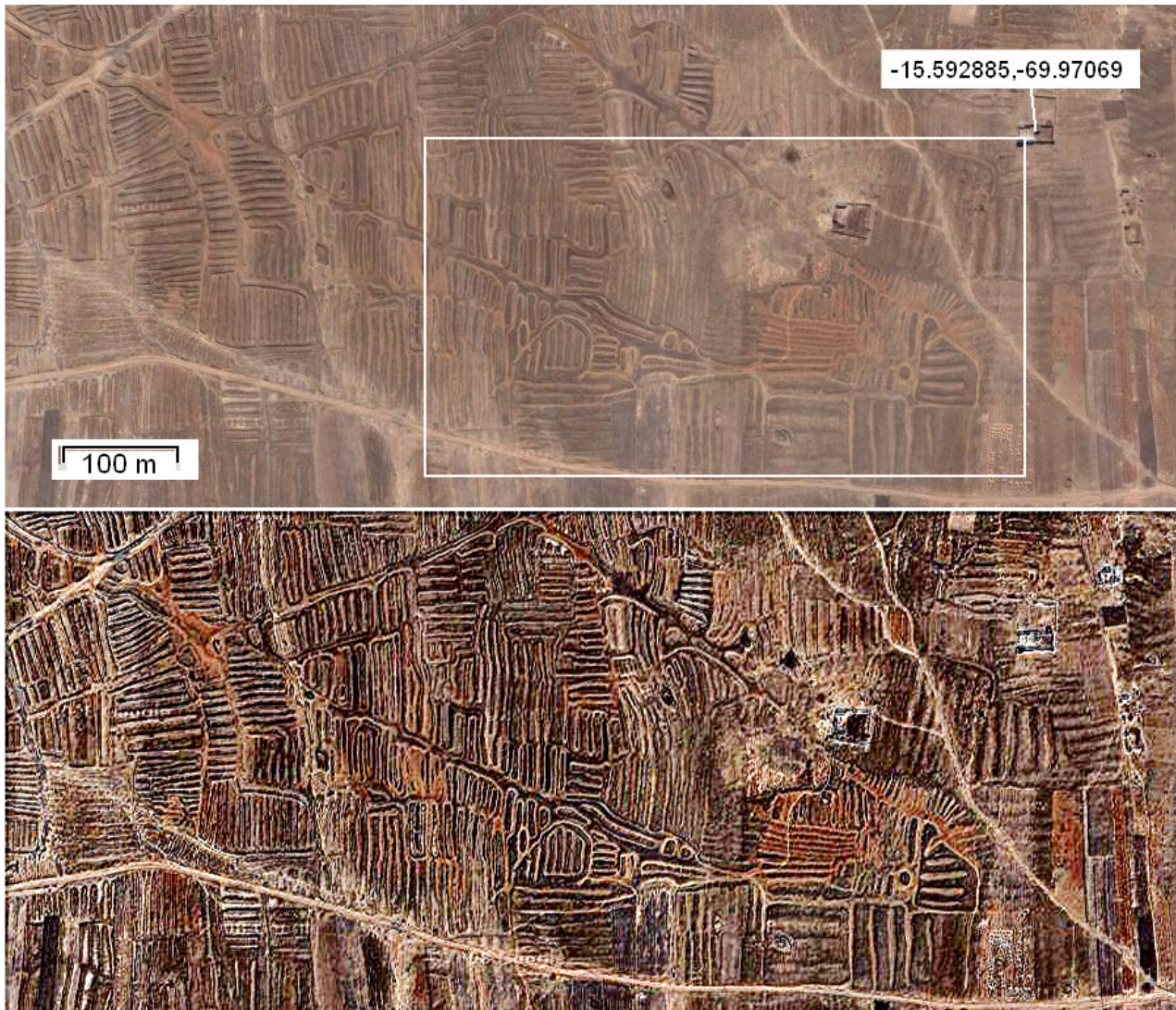
No comment

Peru



Head of a bird. The beak is touching an old dry channel (upside-down).

Peru



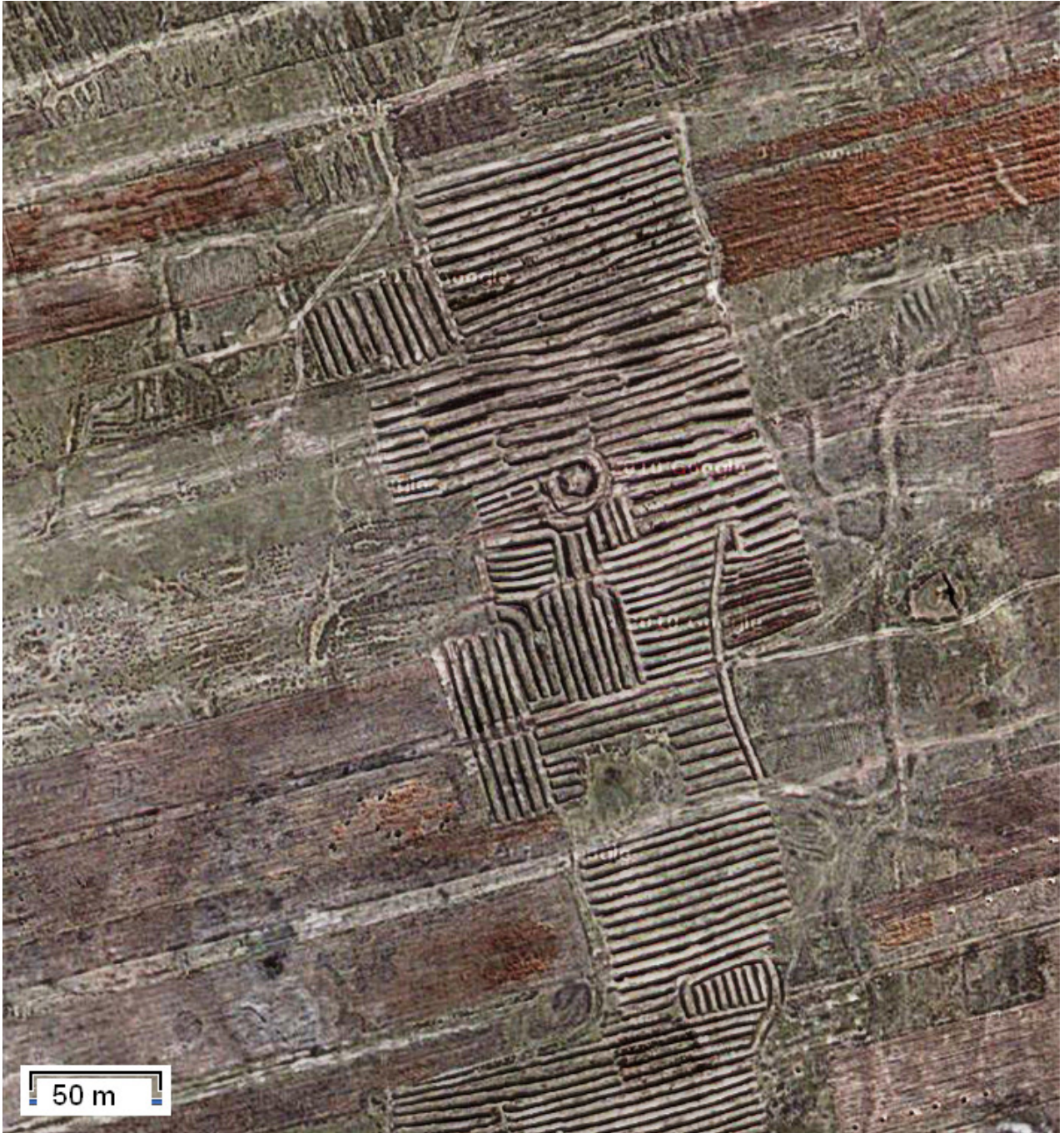
It looks like the head of a bird. In any case, we can argue that the creation of earthworks was previously planned, following the natural slope of the terrain. The image, with a suitable processing, allows observing all the minute details.

Peru



A star and stripes creation.

Peru



The star is at coordinates -15.5068,-70.0024

Another star and stripes.

Peru



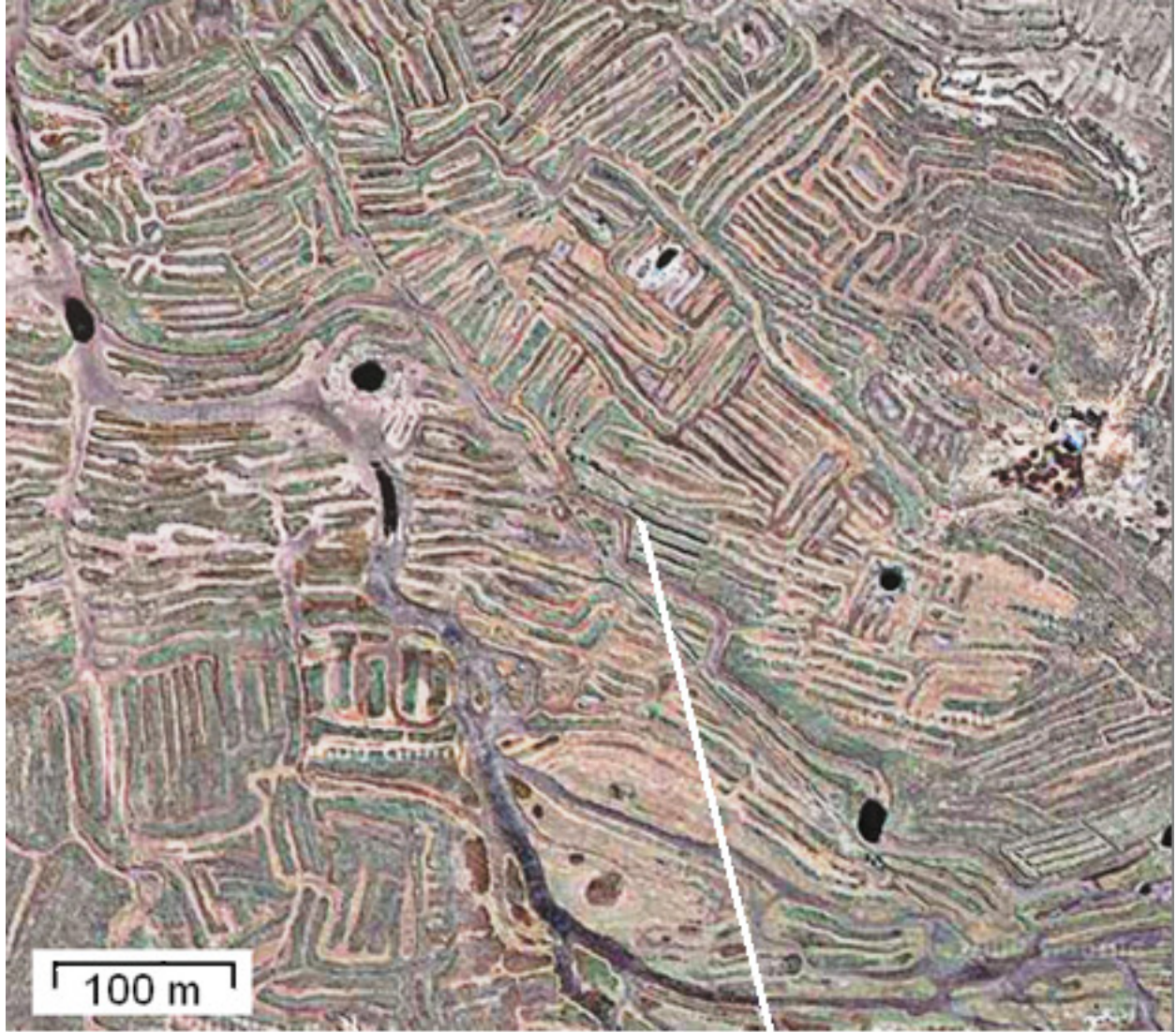
Abstract drawing.

Bolivia



A canal or a snake near Tiwanaku.

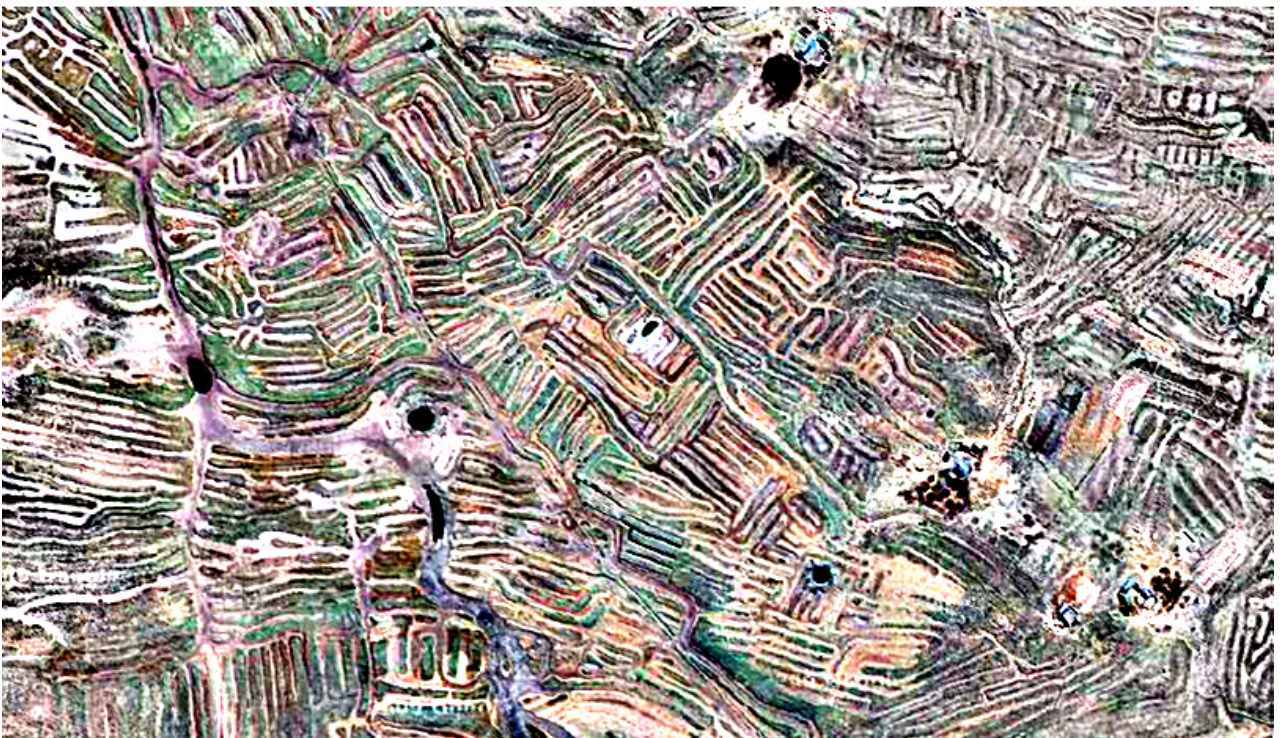
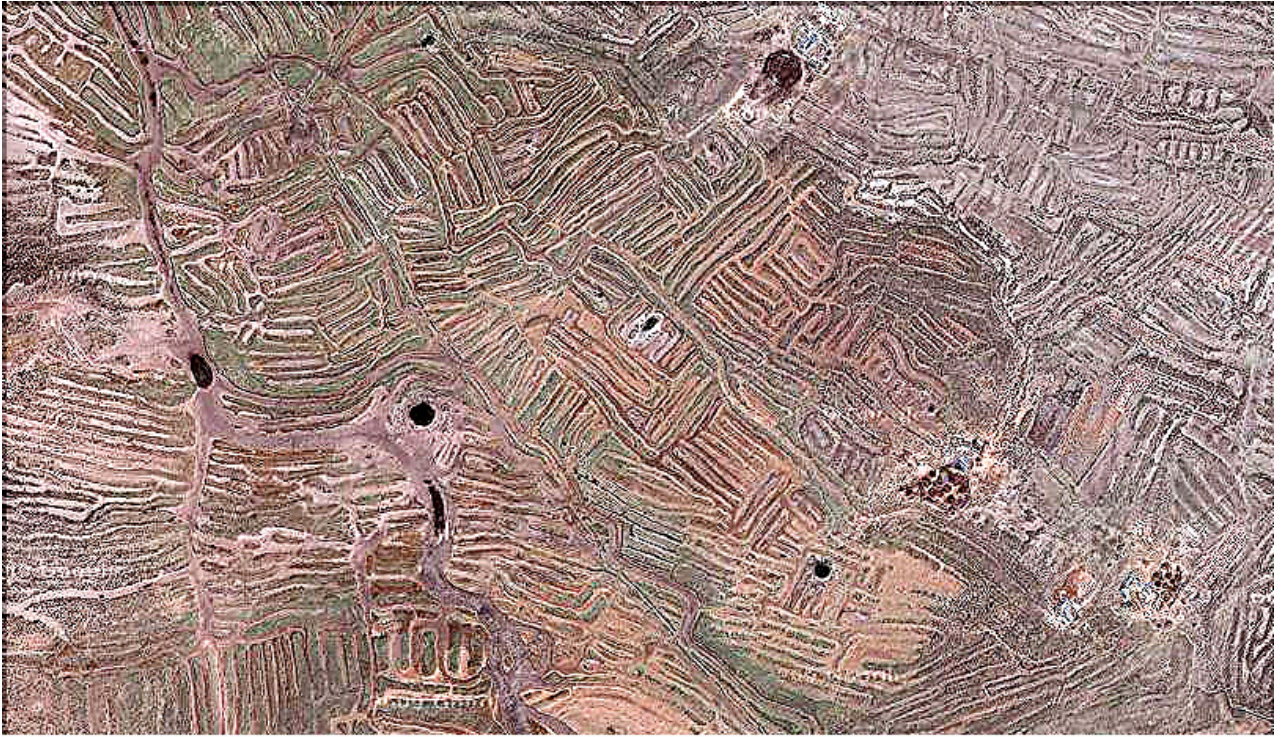
Bolivia



-16.430024,-68.58725

**A snake and a bird near Ancocahua and Aygachi.
Note teeth and tongue of the snake.**

Bolivia



Artistic visions.

Bolivia



The eye is at coordinates -16.425331,-68.585994

A flying macaw.

To be continued