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Masaya, the "Mouth of Hell", Nicaragua: Volcanological interpretation of the myths, legends and anecdotes

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ABSTRACT

Nicaragua's conquest started only 30years after Christopher Columbus arrived to America in 1492. At that moment the Masaya and Momotombo volcanoes were erupting simultaneously. The former was the first permanent lava lake observed by Europeans, and this produced a strong impression and interest in it. For more than a century there was great controversy over the nature of this phenomenon. Some people believed that it was the Mouth of Hell, whereas others could greedily see in the lava a source of gold or silver. This fact led to many attempts trying to prove it. In this paper, aboriginal myths about the volcano are described as well as different ideas and "supported evidence" given by the Spaniards regarding whether it was or not indeed the Mouth of Hell. Moreover, the first detailed geological descriptions are exposed as well as interesting interpretations found in the chronicles. It is also narrated the first descent into the volcano's mouth to extract samples of that "gold", a real exploit for that time. From these descriptions, a volcanological interpretation is proposed, which is a contribution to the understanding of the eruptive history and evolution of the Masaya volcanic complex, one of the largest, shallow magma chamber systems in Central America.

1. Introduction

Only 30years after Christopher Columbus arrived to America in 1492, the first conquerors landed in Nicaragua. Between 1522 and 1523, two expeditions came from Panamá, one on land led by Gil Gonzalez Dávila and the second by the sea under the orders of pilot Andres Niño. Gil Gonzalez's expedition travelled up to the coast of the Nicaragua Lake, where he was welcomed by chief Nicaragua, who accepted the submission under the power of the King of Castilla (DHN, 1954). However, later on, the conquerors faced a strong resistance from chief Diriangen who forced them to travel back the same track they had come. Due to various disputes between conquerors, and inspite Gil González had been the first to arrive to Nicaragua, it was Francisco Hernandez de Córdoba, who had been sent by the Governor Pedrarias Davila of Castilla de Oro (Panamá), who finally secured the conquest in Nicaragua. He also founded the cities of Granada and León taking away the glory yet again from Gil González (DHN, 1954).

Although during the México conquest in 1519 an expedition led by Diego de Ordaz (Hernán Cortes' lieutenant) had climbed Popocatépetl volcano looking for sulphur to prepare gunpowder (Ramírez-Cabañas, 1974), it is Pedrarias Davila's letter, dated 10th April 1525, sent to Emperor Carlos V relating the conquest of Nicaragua by Hernandez de Córdoba, that for the first time describes some volcanic activity in America. The letter mentions the presence of Masaya and Momotombo volcanoes: "… In this province of Masaya there is a large mouth of fire which never ceases to burn and during the night it is so big as if it reaches the sky, and with a height of 15 leagues (75km) there is light as if it was day…" After the conquest of Nicaragua, and since the Spaniards were amazed by the unusual and permanent volcanic activity of Masaya, there are countless chroniclers who have described in detail the shape of the vent and its activity. They also report the beliefs on its origin, whether the molten material was gold or silver as well as the American Indian myths about it. These chronicles are an invaluable source of information for the reconstruction of the volcanic activity of Masaya. They were originally written in Old Spanish, according to the style of the time (XVI and XVII centuries). The attempt to accurately translate the original chronicles' text into English has required a considerable effort in order to make it easy to read and at the same time to faithfully translate the original document.

A summary of the different ideas and theories developed by various authors and their evolution through time is exposed in this work. Furthermore, the strong influence that the Classic authors and the Catholic Church had on the idiosyncrasy of the people is emphasised. Despite this, the description of many of the phenomena is very accurate and some of the interpretations incredibly ingenious.

The authors consider the knowledge of these ideas to be a contribution to the general volcanological culture and to the history of humanity.

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2. Masaya volcanic complex

2.1. Geological and volcanological framework

The Masaya Volcanic Complex lies within a major caldera called El Ventarrón (Viramonte, 1972; Incer-Barquero, 1973) or Masaya Caldera, (McBirney, 1956; Williams, 1983a) and is located 20–25km southeast of Managua, the capital of Nicaragua. The El Ventarrón caldera forms an elongated basin 11.5km by 6km (Fig. 1) whose long axis is oriented to the northwest, parallel to the Central American Quaternary volcanic chain. The complex has a low shield-like form, in contrast to all the other Central America volcanoes.

The Masaya Volcanic complex — a group of spectacular collapse craters and cinder cones — lies near the centre of the El Ventarrón caldera and is composed by the present active crater Santiago as well as Nindiri, Masaya, San Fernando and San Pedro craters (Fig. 2). Together with Media Luna, Los Sastres, El Renón y Comalito cinder cones, it forms an apparent circular structure 3.5km in diameter located near the caldera's centre and may represent the most recent volcanic activity of the caldera. McBirney (1956), and Viramonte (1972) postulated that the vents are distributed around the edge of a buried but active new caldera rim. Williams (1983a,b), has argued against this interpretation, and suggested that the principal structural control on the distribution of the vents is parallel to one of the three main regional fault directions.

The caldera rim reaches elevations of 650m above sea level (average of 320m). The caldera floor rises to a maximum elevation of 550m at the edge of Santiago crater with an average of 265m elsewhere.

At the time of the Conquest in the XVI century, the Nindiri and Masaya craters were the only active craters and the former was the site of a lava lake (Oviedo y Valdez, 1851; Sapper, 1925; McBirney, 1956; Viramonte, 1972; Williams, 1983a). The Nindiri crater (Fig. 2) produced lava flows, cinder cones and lava lakes at different stages of its evolution. This crater was the site of an active lava lake during the time of the conquest and all the references about Masaya as the Mouth of Hell refer to this crater (Oviedo y Valdez, 1851). In 1670 a lava lake progressively filled the Nindiri crater. Eventually the lava overflowed along the north side of the cone (Figs. 1 and 3). The 1670 lava flow covers 2.12km^2.

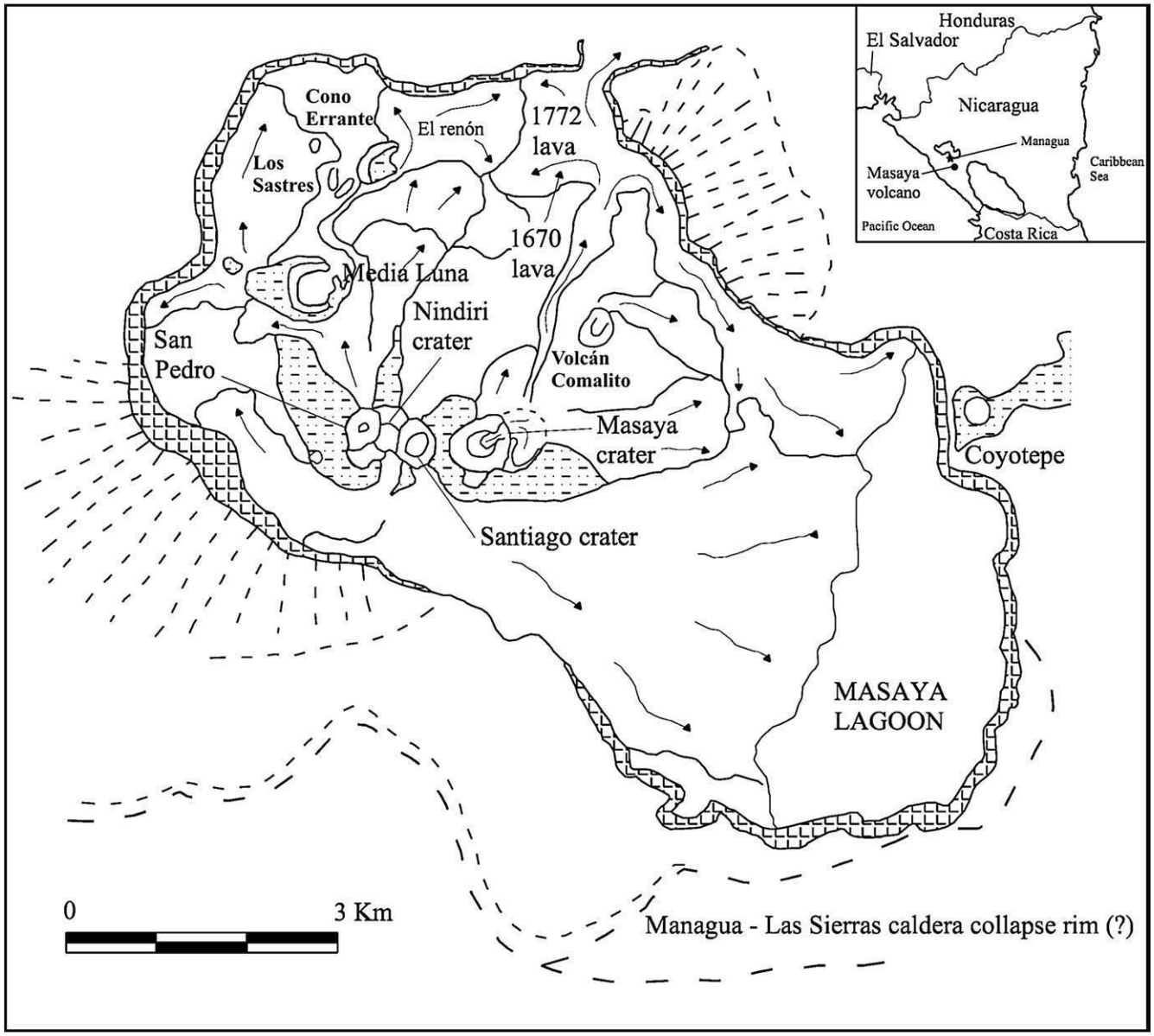

Fig. 1. Schematic cartoon showing the El Ventarrón Caldera and its inner Masaya Volcanic Complex. In the right upper side is showed the regional location of the Masaya Volcanic Complex.

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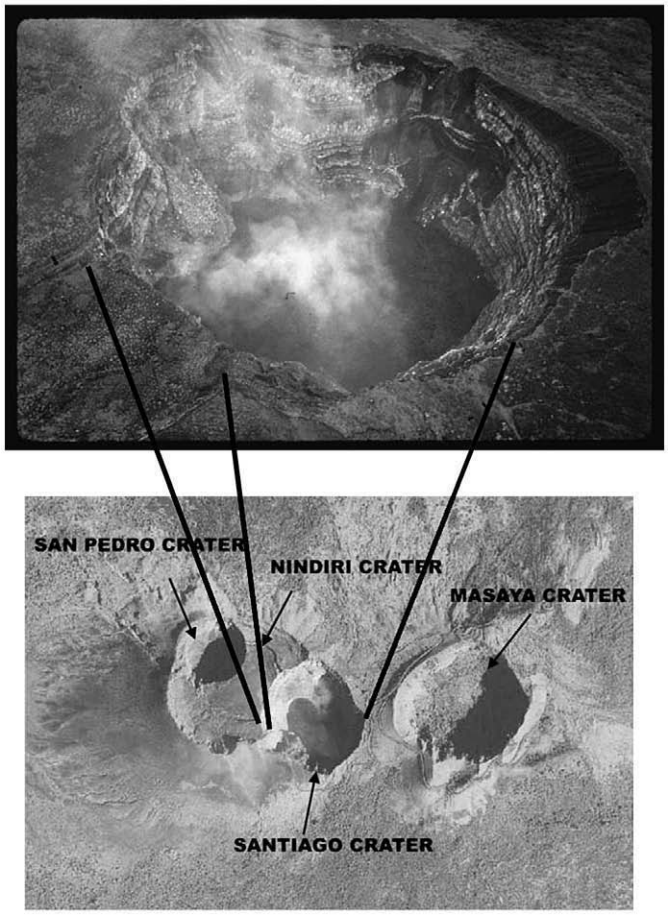

Fig. 2. Aereal photograph of the Nindiri, Masaya, San Pedro and Santiago craters (lower photo) with a detail oblique aereal photograph of the Santiago and Nindiri craters (upper photo). Thick black lines link identical places in two photos. Note that Santiago and San Pedro craters not exist in the XVI Century. (Photo by José Viramonte).

The Masaya crater is formed by a sequence of lava flows, lava lakes, spatter and scoria deposits which crop out inside the walls of the crater. The last recorded lava flow was erupted in 1772 from a fissural vent on the mid-slope of Masaya crater (Fig. 1) and along a north-trending fissure which is the probable extension of the Cofradía Fault (Williams, 1983a).

The 1772 lava flow is the only one known in detail. The flow is 7.51m^2 km^2 (Figs. 1 and 3). Incer-Barquero (1980) and Perez (1975) described that the eruption began at 1 A.M. on the 16th of March 1772 after 2h of strong local earthquakes. The lava flowed continuously for 8days with a maximum run-out of 7km to the north and across to the caldera wall. A second branch flowed 4km to the southeast and entered Lake Masaya. The total erupted volume was 22.5 × 10^{6}m^3 (Williams, 1983a).

During the 1772 eruption, the bishop of Granada, followed by numerous fellows, carried the image of the Christ of Nindiri in a procession and faced the coming lava flow in order to stop it. Oddly enough, the eruption did cease after that For this reason, since 1772, every 16th of March a big religious procession takes place in this region.

The present activity is related only to the Santiago crater, which was formed later (1850–1853). The Santiago crater (Figs. 2 and 4) consists of a spectacular sequence of lava flows exposed in the walls of the crater. The east and north walls expose lavas and scoria previously erupted from the Masaya crater, whereas the west wall exposes deposits from the Nindiri crater.

The Masaya Volcanic Complex lies in the most densely populated region of Nicaragua. The main area of the volcanic complex was declared the Nicaragua's first National Park (Parque Nacional Volcán Masaya) in 1979 (Incer-Barquero and Gutierrez, 1975). Today the Servicio de Parques Nacionales (National Park Service) operates and maintains the Park under the auspices of MARENA (Ministerio de Recursos Naturales de Nicaragua).

2.2. El Ventarrón or Masaya Caldera

McBirney (1956) argued that the scalloped outline of the major El Ventarrón Caldera was evidence of coalescing collapses extending over a considerable period of time. Viramonte (1972) and Garayar (1978) based on morphological considerations and the predominance of pyroclastic deposits in the west and lava flows in the east, postulated the presence of two or more overlapping volcanic complexes which collapsed to produce its present configuration.

Based on detailed geologic data Williams (1983a,b) showed that neither cases are likely. The caldera walls do not show evidence of many local centres building and collapsing over a long period of time and no buried fault scarps were found (Williams, 1983a,b). The stratigraphy is simple and continuous from one caldera margin scallop area to another. Flow structures, where present, indicate a central vent for the flows. The asymmetric distribution of pyroclasts and lava is exactly what one would predict given the extremely regular trade winds which blow towards the west–southwest over the caldera. Pyroclasts accumulate on the downwind side and lavas flow out the lower upwind side, following the maximum gradient.

The study of Crenshaw et al. (1982) suggested the presence of the fault which would be expected to enter the caldera at the south-eastern point where the caldera wall disappears on the south side of the caldera. Williams (1983a) showed that no evidence for faulting was found to support the two or more caldera hypothesis.

Williams (1983a) also found evidence that fissure eruptions were common events at Masaya. This is very rare and essentially unknown at other Central American volcanoes and similar to Hawaiian and Icelandic volcanism. These structures are invariably aligned parallel to one of the dominant fault directions of regional tectonics.

Fig. 3. Bobadilla Cross. View from the NE (Photo by Incer-Barquero).

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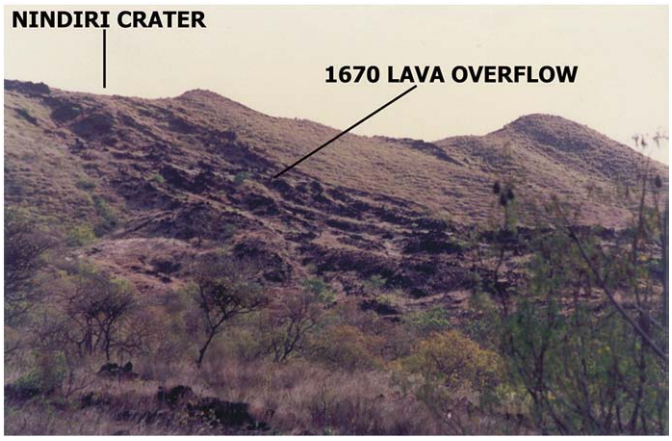

Fig. 4. Detail of the 1670 lava overflow coming donwn from the Nindiri Crater (Photo by Incer-Barquero).

Likewise, Fig. 1 shows an asymmetric distribution of cinder cones and eruptive fissures. They are aligned on the western half of the caldera floor and outside the caldera rim. They are also to the west of and on the inferred location of the Cofradia fault zone as it crosses the caldera from north to south. Most of the fissure vents show an alignment parallel to one of the three regional fault directions.

Structural control of the distribution of vents seems the most likely explanation, given the structural data available. Williams (1983a) showed that major regional faults associated with the central Nicaraguan segment break does not appear to extend beyond the east end of Lake Managua and the Cofradia fault.

The caldera wall shows a succession of different volcanic products. At the base of the section, ignimbrites and lithic-rich mudflows of Las Sierras group crop out at the eastern end of the caldera.

A thick sequence of bedded plinian basaltic airfall deposits, including a 73m thick bed of the Fontana Lapilli (Williams, 1983a,b; Masaya Lapilli of Bice, 1980), and San Judas formation (Triple layer of Bice, 1980) are best represented in the western part of the caldera. Many basaltic lava flows, mainly pahoehoe type, are interlayered in the caldera wall with pyroclastic deposits. Williams (1983a) suggested that pre-historical lava flows may extend as far as 10km from the caldera, covering a surface of about 350km^2 and reaching a volume of 5km^3.

Near the top of the caldera wall sequence, a basic ignimbrite crop out. It is a pyroclastic flow deposit with many features like those typical of felsic ignimbrites but its composition is basaltic with a typical Masaya signature, low Al_2O_3, high FeO contents, and elevated large-ion-lithophile-element concentrations (Williams, 1983a; Walker et al., 1993). At the top of the caldera wall, a basaltic surge deposit is present. Williams (1983a), interpreted this surge as the younger pre-caldera unit, but it may be as well, together with the ignimbrite, the "collapse unit" of the caldera generation.

The presence of a voluminous ignimbrite–pyroclastic surge sequence (Masaya tuff of Bice, 1980) uniformly distributed around the caldera rim strongly suggests that the present collapse caldera entirely postdates the previously described lava–pyroclastic sequence and that collapse was catastrophic and related to a single paroxismal eruption.

All these unusual features led Williams (1983a) to revise the "Masaya type" caldera of Williams and McBirney (1968, 1969) and propose a new genetic model for this type of caldera.

The bulk chemical composition of different samples from Masaya complex shows a generalized basaltic and basaltic–andesite composition (McBirney, 1956; Viramonte, 1972; Williams, 1983a). They have a relative compositional homogeneity, low Al_2O_3 and high FeO contents, a tholeitic differentiation trend, elevated large-ion-lithophile-element concentrations and unusually high $^{87}Sr/^{86}Sr$ and ^{10}Be contents (Walker et al., 1993; Pérez et al., 2006).

Geochronological determination in lava and pyroclastic material gives different ages. Williams (1983a) reports an age of 95,000 ± 45,000BP years for a sample from the base of the wall near Nindiri. The OLADE group (in Williams, 1983a) reports a K/Ar whole rock age of 360,000 ± 100,000years for a lava flow at the base of the wall below Masatepe. On the other hand, the Fontana Lapilli (Masaya Lapilli of Bice, 1980) has been dated in the Managua area at approximately 30,000years (Bice, 1980). Likewise, stratigraphical correlations show that the upper Masaya Ignimbrite–Surge (Masaya tuff of Bice, 1980) deposits have an age of less than 6500years (Williams, 1983a).

This data suggest that the volcanic complex erupted over a long period of time. The caldera collapse, following the ideas of Williams (1983a), took place in recent times (less than 6500years ago).

3. First volcanological descriptions

It was in 1524, with the eruption of Masaya and Momotombo volcanoes that the Spaniards saw for the first time volcanic activity in the New World (Letter from Pedrarias dated 1525 to Carlos V. FPCBA, 1975). From then on, references to Masaya volcano are countless. Amongst them, the most interesting ones are those of Friar Bartolomé de las Casas, Friar Toribio de Benavente, Juan Torquemada, and Adelantado Pascual de Andagoya. Other authors like Lopez de Gómara, Jerónimo Benzoni, Antonio de Ciudad Real, Juan Lopez Velazco and Antonio Herrera mention in their texts the enigmatic crater, repeating the phenomenon witnessed by other chroniclers (FPCBA, 1975).

However, the most interesting and thorough description is that of the first chronicler of the Indies, Gonzalo Fernandez de Oviedo y Valdez, in various chapters of his wonderful text "Historia General y Natural de Indias, Islas y Tierra firme del Mar Océano" (Oviedo y Valdez, 1851).

During a trip to Nicaragua in July 1529, he climbed to the top of Masaya volcano along with the Nacatime chief and three servants. They left Managua on horseback on 25th July 1529, arriving on that same day at Diego Machuca's hacienda located on the coast of Laguna Lenderí (Masaya Lagoon, Fig. 1). On arrival, Oviedo y Valdez went to see the Lagoon and on that same night, started to climb up the " Masaya Mountain to see the fire...", with the company of the " ...Nacatime chief, a slave and two tame Indians of mine...", because although there were two other "Christians" who had promised to go with him "…when they saw Masaya, they didn't agree to come or keep their word […] although many say they have seen Masaya, really they have only seen it in the distance, and only very few dare to climb up it".

He starts describing the rough terrain over which he forced his way in order to gain access to the volcano slope "… like a blacksmith's slag heap…" surely referring to the prehistoric scoriaceous lava flows ("aa" type) that carpeted the Caldera Masaya's floor. At this point he describes the mount as " round and different to the rest of the mountains in the region" and that " its circumference is between 3.5 and 4 leagues..." (17–20km). Then, he continues with a number of disquisitions on the " glow that comes from that mount..." which had been previously described and had even drawn the Emperor's attention. In this regard Oviedo y Valdez is dubious; he states that from the city of Granada, situated 20km to the South, on a dark night with no moonlight, the glow coming from Masaya volcano could be seen. Immediately after that he says: "20 leagues (100km) away from this sierra I have clearly seen that glow; but although it looks like flames (Fig. 5) coming from the mouth of it, actually it is not fire but rather incandescent smoke". In addition he states that he doesn't agree with those " …saying that at 3 leagues [5km] from the mount, such was the light coming from it, they could read a letter — and I don't agree— […] as I couldn't read a Breviary of the Hours that I had with me, although I was standing less that a quarter of a league from

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Fig. 5. Detail of Santiago crater wall. Section of around 24 lava flows erupted from Masaya crater, overlies of cinder and lapilli cone at left, which represent the Santiago Crater Complex (Williams, 1983a). (Photo by J. Incer-Barquero).

the top of the mountain…" These different opinions on the intensity of the light emitted by the magmatic activity are probably due to the changes in the climatic conditions and not to the increase or decrease of the activity itself. It is possible that on clear and cloudless nights the glow was less intense, whereas on moonless and overcast nights it could be seen from farther away.

At the summit of the mount, he describes a great mouth or abyss formed by a big inter-crater (see Fig. 2 crater Nindiri) "… and it was so big and round that no shotgun in my opinion would reach from one side to the other "[....] and it is a very round plaza (" plaza" in the original is approximately 850m diameter) so big that a hundred horses could play "cañas" [canes game] and where there is not a hole (inclined to the south) it would be even greater the number of people that could fit in it […] Towards the south border of that great plaza there is a hole, as I have already mentioned…[the lava lake]" (see Fig. 2). In 1548, the Governor of the province of Nicaragua, Rodrigo Contreras, told Oviedo y Valdez that he had measured the height from the summit to the first inter-crater to be 130fathoms (approx. 230m) as well as the distance from the crater's edge to the lava lake's surface to be 40fathoms long (approx. 72m).

Numerous previous and posterior descriptions to the Oviedo y Valdez one (Bobadilla, Machuca, etc) expose that the lava lake's position as well as its level was extremely variable, changing from central positions and levels near the crater's edge, to be displaced toward the south with drops of lava levels (50 to 70m from the edge). Furthermore, from the stories collected by Oviedo y Valdez (1851) from the aboriginal people, we can suspect that the magmatic activity was previously located in the Masaya crater, (see Fig. 2) which then was named Nindiri crater.

Oviedo y Valdez (1851) describes the lava lake as follows:

[….] "At the bottom of that hole there was a fire that was liquid as water and that matter was burning more fiercely than red hot coal and more ardent in colour; burning more than any fire can ever burn, if that is possible. All of that matter filled the bottom of the hole and was boiling." Oviedo y Valdez continue saying "in fact, not the entire bottom of the hole was boiling, just some parts of it, and those parts changed from one place to another, the bubbles reappearing here and there, a never ending gurgling". And in those areas where the boiling ceased, a kind of rough and cracked coat, skin or layer was formed, showing fire through its fissures, liquid as water that which lay beneath it. From time to time all that matter gushed out, spitting upwards many drops which turned back into that same matter or fire when falling back down, in my view they rose about a stadium in height (167m). Sometimes these drops fell on the edge of the hole away from that fire and to extinguish it took the same time so as to say 6 times the Creed [approx. 5min] in a similar way to that of the smith's forge". Later, Oviedo y Valdez (1851) describes the experience of Fray Blas del Castillo (who nine years after Oviedo y Valdez's trip descended on several occasions onto the "plaza" with the aim of extracting samples from the lava lake thinking it was gold or silver) as follows: "This father says that the mouth of Hell is like a bell with its mouth turned upside down and becoming narrower towards the bottom […] "Regarding what he saw in the plaza, he describes massive slides, rocks with colours ranging from white, red, black, blue to yellow and brown, as well as dikes cutting through the crater wall […] strips or veins, coming down from different kinds of ravines towards the boiling matter, some in a straight fashion and others curling and uncurling like a snake […] and these veins are wider than one and a half or two hand spans". When talking about the lava lake he describes the existence of two main lava fountains and towards the ENE wall a lava spring " like a river of a metal which appears to be of the same type as that of the lake […] that cave emanates a dense cloud of smoke towards the lake, and more smoke comes from that cave that from the whole lake...".

The above mentioned description fits perfectly the existence of a main crater (the plaza) filled by flats pahoehoe lava flows, with a diameter of about 800m where a inter-crater had opened towards the south (at the time of Oviedo y Valdez's visit), in which a permanent lava lake was located with multiple, frequent and strong lava fountains whose scoriaceous emissions reached the edge placing basaltic scoria with continuous and great roaring. Another important thing to notice is the description of the dikes cutting through the caldera's wall, and the presence of fumarolic alteration and sublimates which indicate fumarolic activity from the lava lake.

It is worth mentioning that a similar situation, without a permanent lava lake but with a small permanent incandescent and central "furnace", is currently happening at the current active crater Santiago; this may suggest the re-occurrence of similar type of volcanic activity over the centuries.

The main crater (Nindiri) must have been frequently filled with fluid lava flows emitted from the central inter-crater where there was the permanent lava lake. It is quite possible that during the 1670 eruption the main crater was completely filled and the subsequent overflowing lava generated the 1670 flow (see Fig. 2), which afterwards produced the collapse and subsidence of the crater's bottom. This eruption marked the moment where the lava lake, which had lasted for more than 150years, ceased to exist. In contemporary times, this kind of phenomenon has occurred in Santiago crater (see Fig. 2) on various occasions, however, with lower energy levels.

Between 1968 and 1972, many pahoehoe lava flows were emitted and filled the main crater floor. Afterwards, the small central cone collapsed and gave way to an inter-crater where the incandescent activity was maintained for many years. Furthermore, it emitted a degassing plume which gradually expanded the size of the inter-crater's diameter. In recent times a new collapse opened a second inter-crater which is the currently active crater.

The above suggests that the eruptive mechanism of the Masaya Volcanic Complex is recurrent and it is associated with fluctuations in the level of magma, in a large, shallow, open-system magma chamber, and perhaps following Walker et al. (1993), with a size in the order of 10km^3.

The magmatic activity is of the Hawaiian kind with frequent lava flows with high emission rates which later produce opening of new

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pits by collapse. Although the presence of magma in Masaya has been continuous throughout history, it would seem as if the level of activity since 1772 has been decreasing.

On the other hand, Fray Bartolome de las Casas (1566) recounts that eruptions took place especially during the rainy season " the fire explodes with great fury..."; this may be related to phreatomagmatic activity(?). He also mentions that the volcano produced a huge amount of "sponge-like stones" (in reference to pumice stone and scoria) throwing further away the lighter stones and closer the heavier ones (scoria and lava). In this fashion the higher part of the volcano is covered in this denser rock " ...like a blacksmith's slag heap..." and the pumice stones are in the valleys. It is remarkable the way he describes the texture of the scoria and bombs "… cracked like bread crust…". Even more interesting are his ideas on the origin of the volcanoes and the presence of pumice stones or dense lavas: a principle problem was to fathom out what fuelled the "fire" of the volcanoes. Regarding this, he says: " ...and I have no doubt that this metal, some kind of iron or copper, must feed this fire like a log does. The waters bring down some parts of the surrounding walls and they fall into the hole where the fire is. These stones must be **"metalina"** (textual in the original) and the sponge-like stones must be full of juice or bitumen feeding the everlasting fire. So when the juice or bitumen of the sponge-like stones are totally consumed, the stones are left empty and with little weight and the volcano is able to throw them far away whereas those with juice still inside [scoria and lava] can be thrown a short distance only." Years later, Torquemada (1615) adheres to this idea saying "… and I believe the ground of this sierra is juicy, with the juice of that matter feeding the fire, the one inside the sponge-like stones; and when the humour or juice is totally consumed by that metal or fire, then they are left lighter and can be spat far away…"

Lastly it is worth pointing out the ideas of Fray Bartolome de las Casas (1566) and Torquemada (1615) regarding the connexion between all the regional volcanoes, agreeing also with Fray Blas del Castillo, that the Masaya lava lake was a flowing lava river. In this regard they say: "… after seeing it, there is no doubt left, because it is a true and natural thing: That river of fire and burning metal travels through its pipes underneath the earth to the other volcanoes, and there are many of them in the province. It always keeps its consistency like Sulphur stone, bitumen or that metal similar to iron or copper".

4. The Mouth of Hell

From the beginning of Nicaragua's conquest, the Spaniards referred to the Masaya Volcano as "The Mouth of Hell" or simply "Masaya's Hell" (Infierno de Masaya in Spanish). This name was also following the tradition of the Aboriginal people who believed that the Masaya volcano was a god. They made offerings and human sacrifices throwing into the incandescent crater children and maidens, sending them to "fetch water" during the drought seasons. Also, the aboriginal chiefs of the region, when solving important matters, asked for "secret advice" (Monexico in Nahualt language) to a sorceress who appeared inside the volcano. She was described as "an old woman with long and spiky hair, sharp fangs and breasts reaching her waist" (Oviedo y Valdez, 1851). It is thought that this sorceress of the volcano was Chalchiutlicue, the water deity in Mexican mythology which was inherited by the Nicaraos. This image was similar to that which the Spaniards had of the Devil which, added to the idea that all the aboriginal gods were product of the Devil and contributed to the belief that the volcano was the mouth or gates of Hell. This led to Mercedarian Fray Francisco de Bobadilla climbing the volcano in 1529, where he erected a cross in order to exorcise what he called "The Mouth of Hell" (Figs. 5 and 6).

The Spaniards did not have in those days much volcanological experience. Except scarce references to Vesuvius, Vulcano, Stromboli, Etna or old descriptions from the classical authors (i.e.: Plinius The Elder, and his nephew Plinuis The Young, etc). As stated by the first chronicler of the Indies, Oviedo y Valdez (1851), very few people had

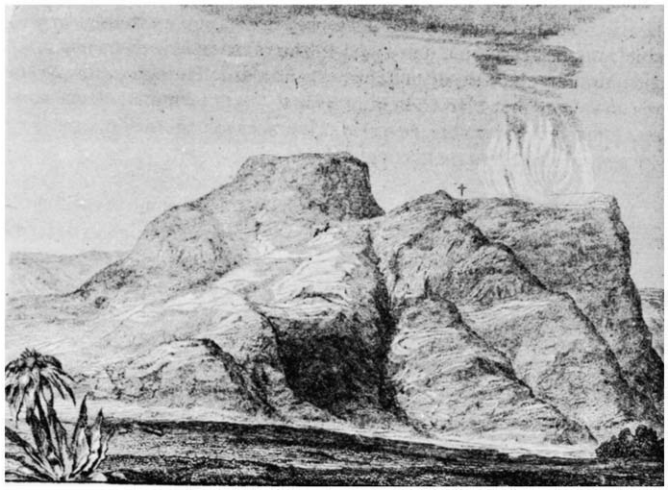

Fig. 6. Reproduction of the illustration of the Masaya volcano by Oviedo y Valdez (1851). Note the Bobadilla Cross

seen a volcano, let alone a volcanic eruption and never a permanent lava lake. The existence of permanent lava lakes was an unheard phenomenon amongst European people of the time. Popular notions of the time regarding volcanoes (even amongst educated people as the friars) was were the classical one derived from The Dialogues of Saint Gregory (Book IV Chap.36) in which he states that volcanoes are the Mouths of Hell. This is evidence of the strong influence of the Classics and the Catholic Church over the thinking of this time.

Other Frairs, like Fray Bartolomé de las Casas, in 1535, interpreted that in general, volcanic activity and particularly eruptions, were due to strong winds produced by water movement (either the sea or near lakes) which got into the Earth through caves "turned on the Sulphur or bitumen and in this way the produced the fire" until all the fuel was consumed. Another Fray, Toribio Benavente (Motolinia) (1541), thought that "the Earth's body was similar to the human body, with veins, cavities and mouths through which it breathes and it is there where a strong and warm wind blows, and it lights the Sulphur of the Earth's interior; it spits fire, smoke and ash through those chimneys that we call volcanoes". The Carmelite Fray Antonio Vazquez, who visited Nicaragua at the beginning of the XVII century, speculates on the possible causes of the volcanic eruptions, thinking that they were the Earth's vents from which the "fire of Hell" escaped. According to the theologians of the time, Hell was located at the centre of the Earth and according to the cosmographers it was exactly at 1030 and three quarters and a half leagues from where the humans lived!!! Furthermore, many of them pointed out that all known volcanoes, sometimes spat out fire smoke or ash and other times they didn't. The big difference was that the Masaya volcano never ceased doing it and was in permanent activity. This led Friar Toribio Benavente (1541) to say "that the fire of the volcano of Nicaragua [Masaya] **without fuel** (…), must be the mouth of Hell and its fire must be supernatural and hellish, and the place from which the condemned are thrown by the demons" and further on, he makes a comparison with the Vulcano volcano (which in The Dialogues of Saint Gregory is named as the Mouth of Hell into which King Theodoric was thrown) and adds "thus, if that one [Vulcano] is the Mouth of Hell, this one [Mayasa] not only seems to be the Mouth, but is Hell itself". Lastly, in that time there were very popular versions told by sailors, who had visions of demons when they were near "those mountains that spit fire". They also heard cries of the condemned or voices that mocked them and untied the ropes, lines and riggings if they didn't make the sign of the Cross.

All of the above made the Masaya volcano be considered the Mouth of Hell for a long time and various Friars used it as a reminder to the faithful of the horrors awaiting those condemned to Hell.

Despite this, the descriptions made by the non-geologist friars are amazingly accurate and precise and they have enabled the

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reconstruction of the Masaya's volcanic activity in the XVI and XVII centuries, which otherwise would have been impossible to achieve.

5. Gold, silver or scoria? The adventure of the first descent to the lava lake

In spite of the controversy over the nature of the Masaya Volcano, some people, who were more pragmatic and greedier, ignored the warnings and believed that there was gold and silver in it. Over the XVI century numerous attempts to obtain samples took place. The first and most famous was carried out by Friar Blas del Castillo in 1538. His odyssey was thoroughly described by Oviedo y Valdez (1851) and he dedicates numerous chapters of his great book to give account of the different incidents and obstacles faced by the adventurous and greedy travellers.

On 13th April, 1538, Friar Blas del Castillo walked for the first time inside the volcano's crater (Nindiri) without any technical support. "Non nobis, Domine, sed nomini tuo da gloriam" (Not to me, my Lord, but to You the glory) muttered the frightened Friar whilst walking on the ashes and basaltic rocks that covered the bottom of the crater. He carried a wooden Cross in one hand to ward off any devilish courses, and held a hammer in the other hand to hit the seam of that yellow metal that he had seen from above and shone like gold. The explorer priest's life pended on the assistance given by three fellows from the top of the crater. Incer-Barquero (1990a,b) makes comparison between this deed carried out without any technical means and the one performed by North American astronauts four centuries later when they landed on the Moon.

The descent was carried out with the utmost secrecy because they didn't want to share the gold they were expecting to find inside the crater and the friar had told to his fellows: " ...keep your silence, God doesn't want the gold to be discovered by the rich, but rather by the poor and humble...". They spent several months studying the site, measuring the crater's height and carrying up to the volcano all the necessary equipment without arousing suspicion. They then put together lathes, chains, ropes and containers for the extraction of the "gold". When the moment came to go down into the crater, Friar Blas, was dressed in a extravagant fashion. He was inside a basket with his habit wrapped and tied up around him, his stole crossed and tied around the chest, a hammer next to his waist, and to protect his head an iron helmet hidden under a straw hat. He didn't forget his wooden cross to scare away the demons, as well as a flask full of wine to quench his thirst and give himself some courage in case he needed it. The basket carrying the friar landed on a pile of stones. He untied himself and continued his way down after kissing the ground and thanking God. When he reached the bottom of the "plaza", the depth was such that his accompanying fellows lost sight of him. The friar hammered the rocks and collected samples for more than 3h. There were no springs of hot ashes and the temperature was tolerable like on top of the hill, although every so often hot and sulphurous vapour came through the cracks.

He hammered the bright crusts which he thought were melted silver. The hole with the "gold" in it was in the middle of the "plaza", bigger and deeper than what they had estimated from above. The extraction of the metal was going to need a joint effort from many people. Once the friar was raised and rescued back, they returned to the city of Granada in order to look for more help. On the Holy Tuesday, 16th April of that same year, after having attended to Mass and confessed, the group discussed who would go down first; they drew lots to set the descent order. The expedition members descended into the crater and worked hard day and night to mount pulleys and devices in order to extract the metal. Aided with a chain, they lowered the iron container to collect the samples. Only after a couple of attempts, the container touched the igneous surface but it got stuck and it proved difficult to get off. Eventually, they managed to raise the semi-melted sample with many incandescent scoriae. Totally exhausted and tormented by thirst, they decided to leave the task, as they also realised that more chains would be necessary. They also agreed they would say there were gold and silver, but they wouldn't show the obtained samples. The astute friar kept the samples in a chest of his without letting anyone to see it, a fact that made the rest of the group unsettled and angry. They then decided to give account of what had happened to the Governor Rodrigo Contreras. Faced with this situation, the friar didn't have any choice but to send a letter to the governor explaining his discovery and saying that "…it shouldn't be" would be a profitable business, orders the friar to organise a third descent, but this time he wanted to be present. On 30th April, the friar and 7 other people descended again into the crater. After several unsuccessful attempts, they could finally submerge the iron container into the melted matter and only after great effort they could haul it up full of scoria. These were the only samples they managed to get, as in the fourth attempt the container became glued to the melted matter and the chain broke.

Once the party was out of the crater, the samples were taken before Governor Contreras and it was verified that the matter neither was gold nor was silver, but vulgar basaltic scoria!!

At the friar's insistence, the governor took the samples to the city of Leon in order to get them analysed at the Foundry (part of the Mint), but the results obtained were again negative. The angered Governor banned Blas del Castillo from carrying out new prospecting. The stubborn friar was not discouraged and decided to go to Spain to obtain all the rights and authorisation necessary to carry out his wild dream directly from the King. Back in Nicaragua, he died after disembarking, and although bearing the Royal authorisation, his fantasy could not be fulfilled. Without knowing it, Friar Blas del Castillo had become the first volcanologist of the New World…

Despite the results of the analysis carried out by the Governor Contreras proving that neither gold nor silver existed in Masaya, Blas del Castillo's adventure was not forgotten. Stubbornly, Juan Sanchez Portero, one of the fellows accompanying Blas del Castillo on the second descent, also obtained a Royal authorisation, but he couldn't defeat the Governor's opposition. After that, the Dean of the Cathedral of Leon, in 1551, asked the Emperor for 200 slaves to drill a tunnel through the crater's walls in order to empty it from all its gold!! The Emperor refused the petition saying that he didn't have any funds available. In 1573 the Carmelite Friar Alonso de Molina obtained the concession to exploit the "gold" with the condition of giving 1/5 of the richness to the King. In 1586 Benito Morales was authorized authorised to "find the volcano's secret", but it was too late because by that time the lava lake didn't exist any more (Incer-Barquero, 1990a,b).

6. Why is Masaya volcano not the real hell?

During the XVI century and also the beginning of XVII, the Masaya volcano was involved in a long and heated controversy regarding its origin. As stated before, it was considered and named "Masaya the mouth of Hell". Others from a more scientific point of view speculated with diverse ideas on its origin.

In 1615 the chronicler Friar Juan de Torquemada, parting from disquisitions on the origin and nature of volcanoes, made a simple and interesting theological analysis stating why the so called "Masaya the mouth of Hell" could neither be truly Hell nor could volcanoes in general be mouths of Hell.

Taking into account all the references and facts already mentioned, Torquemada (1615) says: "…destroying fabrications made up by simple and uneducated people, and speaking to the scholars and wisemen, I say that it is very easy to answer all of what has been said, in particular to what has been said about volcanoes' fire, and I deny that it is Hell's fire..." and immediately he explains why he believes so: "… because Hell is the prison made by God for those who are condemned, therefore the fire of Hell should only harm nor hurt those who by His just judgement have been sentenced to torments and pain.

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Nevertheless, we see the fire from those volcanoes **can kill anyone and destroy the fields in which it runs: therefore it is not Hell.** Moreover, souls are incorporeal, so there is no need for Hell to have mouths. Likewise, if that fire was Hell it should be very dark, like smoke with no light, because in Hell there can't be anything that could cause joy to those condemned. Lastly, according to Saint Basil and other saints, Hell fire not only does not have light but also burns and scorches more than this fire from the volcanoes, which also has light and glows, **therefore it is not Hell".**

As for what uneducated people say, that they hear voices and other things, I say that it must be all fabrications of them. They think the soul, when it is not within the body, can cry and scream from Hell, as if they were still amongst the living; all this is false because souls neither can cry nor can scream as they don't have body or vocal organs.

As for the sailors saying they were mocked by the demons, if that is true, it is only due to the Divine Providence who allows that kind of thing for the confirmation of our faith and so we may value the power of the Holy Cross…"

Lastly, Torquemada wisely interprets Saint Gregory's texts about the hermit's vision of King Theodoric, that for more than 800years it had led to the belief that volcanoes were the mouths of Hell. The vision described King Theodoric being led and thrown into the Vulcano Volcano (and hence Mouth of Hell) by those who he had persecuted and tortured (Pope John and Patricio Simaco). Torquemada argues "as per the vision of the soul of King Theodoric [] it is wrong to conclude that the mouth of the volcano is the mouth of Hell or its fire a hellish one, because what appeared was not truly King Theodorico's soul, but rather that demonstration was done (...) by the Will of God in order to make us understand that the man who had so fiercely unsettled and afflicted the Church was now condemned to suffer in Hell...". "The condemned souls are not being carried by Saints but by Demons…"

The preceding paragraphs demonstrate the great influence exercised by Classic authors and especially the Catholic Church up until the Renaissance where slowly, at first but later with more determination, other interpretations began to be sought to explain natural phenomena.

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