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GEOLOGY

Unusual Eruption of the Main Pugachevo Gas–Water–Lithoclastic Volcano of Sakhalin in Winter 2005

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Volcanologists are well aware of periodicity in the activity of virtually all present-day volcanoes: relatively short-term vigorous eruptions are separated by longer periods of relative calm or repose right up to complete cessation of any visible or perceptible activity. This scenario refers in full measure not only to genuine active volcanoes (gas–lava–pyroclastic), but also to so-called mud (gas–water–lithoclastic) volcanoes [3–5].

Sakhalin is the only region in the Russian Far East where recent active gas–water–lithoclastic (hereafter, mud) volcanism is widely developed and has long been known. Among four regions of mud volcanism developed on the island, the Pugachevo group of the Great (Main or Central) and two minor (secondary or accessory) volcanoes (Fig. 1) is characterized by the greatest number of violent eruptive centers, diverse and specific patterns, and very high activity. According to [1–8], vigorous eruptions of the Main Pugachevo Volcano (MPV) occurred on June 24, 1911; October 17, 1929; November 20, 1933; May 7, 1934; September 1, 1934; June 27, 1935; August 29, 1952; August 31, 1952; September 25, 1961; and August 31, 1967. These precisely recorded eruptions can be supplemented with tentatively recorded eruptions in 1906 and 1948. In 1975, we started short-term observations of the activity of the MPV and recorded eruptions in 1988, 1996, April 2002, autumn 2003, and winter 2005.

Despite the violent (up to explosive) character, almost all the eruptions ended with the outflow of a liquid water- and gas-oversaturated lithoclastic mass (pulp) from one orifice. The pulp flowed uniformly from the eruption center along all directions to form a new rounded (flattened bun-shaped) lithoclastic field (50–200 m in diameter) with the characteristic regular concentric-zonal structure of its lumpy–cellular surface. The size of the new field sometimes regularly decreased from old to young fields. In such a case, one can see that the youngest field is rimmed with ring-shaped margins of two or three preceding zones. A similar concentric-zonal but wider area developed beyond the 200-m limit of the field is overgrown with different grasses. The external zone is predominantly represented by larch forests.

The sole exception to this general rule was the eruption in May 1934, which produced the largest lithoclas-

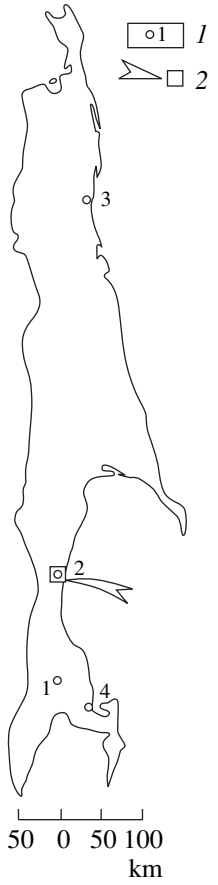

Fig. 1. General scheme of four regions of mud volcanism in Sakhalin (*1*) and the location of the MPV (*2*).

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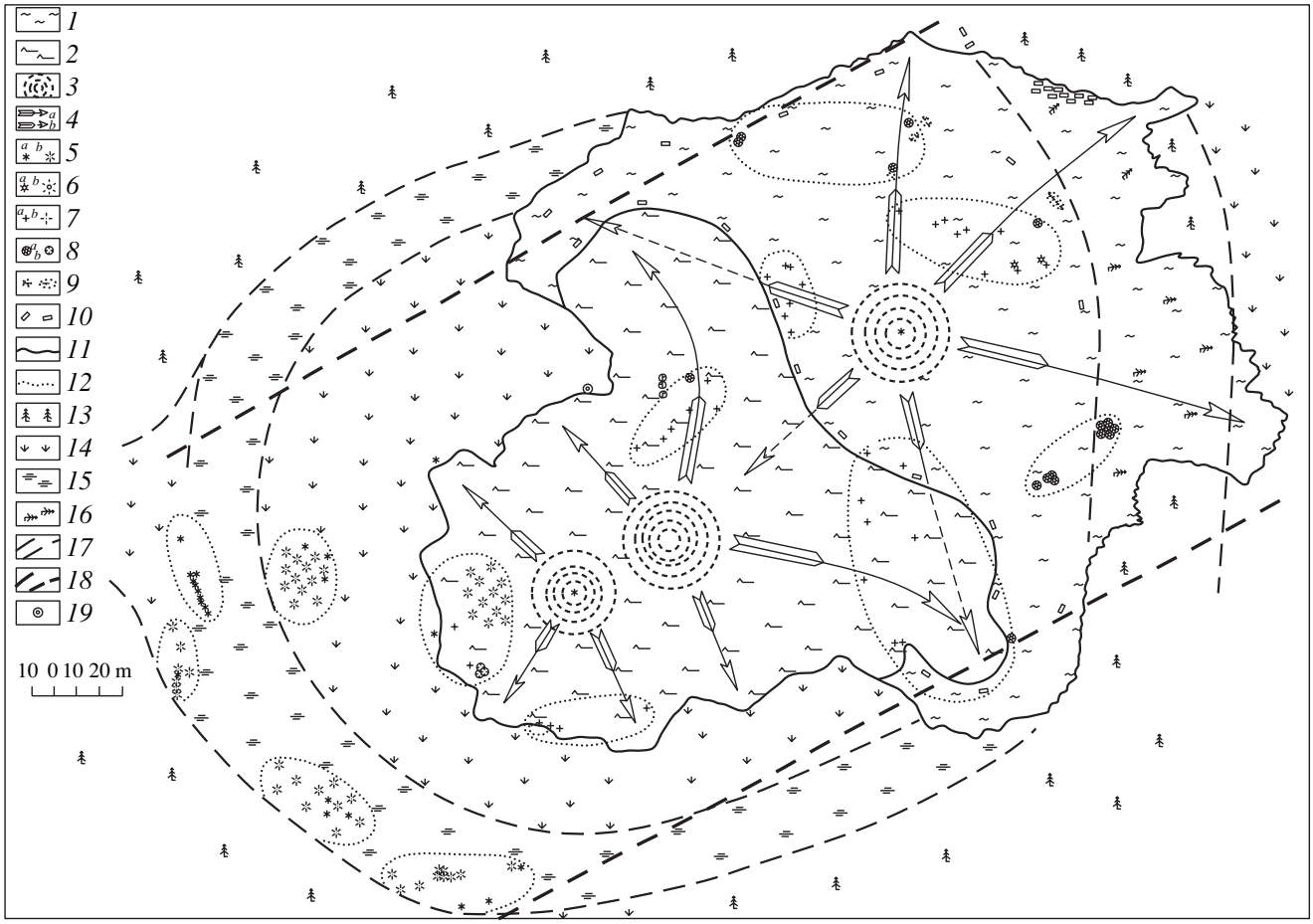

Fig. 2. Schematic map of the MPV after its eruption in winter 2005. Compiled by O.A. Mel'nikov based on GPS data. Scale 1 : 1000. (*1, 2*) Fresh lithoclastic fields formed after the volcanic eruption in winter 2005: (*1*) from the ENE eruptive center, (*2*) from two WSW eruptive centers; (*3*) location of eruptive centers with a distinct regular concentric structure of the surface of lithoclastic fields around them; (*4*) direction of the lithoclastic mass flow: (*a*) well-preserved, (*b*) presumably buried; (*5–8*) gryphons of different morphological types and sizes: (*5*) cone-shaped largest: (*a*) active, (*b*) dormant, (*6*) cone-shaped medium-size: (*a*) active, (*b*) dormant, (*7*) microgryphons: (*a*) active, (*b*)dormant, (*8*) caldron-shaped: (*a*) active, (*b*) dormant; (*9*) mounds reflecting the roughness of the buried relief; (*10*) large fragments of former sod cover pulled up, dragged, and scattered in different directions as a result of the eruption from the ENE eruptive center; (*11*) marginal boundaries of fresh lithoclastic fields and the boundary between the lithoclastic field of the ENE eruptive center and lithoclastic fields formed by two WSW eruptive centers; (*12*) boundaries of gryphon clusters; (*13–16*) marginal zones around the MPV: (*13*) thick larch forest, (*14*) thick grass, (*15*) highly wet, waterlogged zone with small puddles on the surface, (*16*) thick larch forest with trees partially overturned, broken, pulled up, and dragged to some distance as a result of the intrusion of lithoclastic mass flows; (*17*) tentative boundaries of zones; (*18*) boundaries of the retained NE-oriented gryphon belt; (*19*) retained tractor wheels.

tic field in the region. The eruption proceeded not from one but three or four centers. The westward-directed powerful lithoclastic flow completely overlapped a wide zone with different grasses, reached the larch zone, and overturned more than 50 trees [7].

On August 12–13, 2005, we inspected the consequences of the last eruption of the MPV in winter 2005. On September 16–17, 2005, we compiled a schematic large-scale (1 : 1000) map of the volcano using GPS observations (Fig. 2). These materials suggest the following conclusions.

1. The MPV eruption in winter 2005 was nearly an order of magnitude more vigorous. Moreover, this eruption was characterized by several unusual features. The lithoclastic mass erupted by the volcano covered an area of no less than 100 000 m^2, and its volume was no less than 100 000 m^3.

2. Unlike previous eruptions, which usually formed rounded lithoclastic fields up to 200 m in diameter and proceeded from one center, the new eruption took place from three centers located on one straight line striking along 60°–65° and the new lithoclastic field was characterized by an extraordinarily whimsical shape.

3. Previous eruptions of the MPV formed lithoclastic fields in the center of an open oval space bounded by consecutive zones of different types of sod–grass cover,

which is not altered by eruptions, and newly forming larch forests. In contrast, the eruption in winter 2005 produced a lithoclastic field that covered not only the central part but also the entire eastern part of the former open oval area. The lithoclastic field intruded into the eastern thick larch forest 60–70 m, resulting in the overturning and breaking of numerous large trees.

4. In contrast to the majority of previous eruptions, the MPV eruption in winter 2005 was characterized by a diverse and multistage character. It started as a vigorous explosive emission of gas (without visible traces of combustion) from the east-northeastern (ENE) eruption center, which broke apart and extensively threw about scattered angular fragments or shreds of the sod–grass cover on different sides. This was followed by vigorous eruptions of a liquid lithoclastic mass from the same center. Finally, a slightly different (in composition and appearance) lithoclastic mass poured out from the two west-southwestern (WSW) centers. Upon collision with the previous field produced by the ENE eruption center, the new field was forced to change its direction and flow around the older field. Therefore, the new field has a prominent peculiar (bulb-shaped) boundary.

5. The gryphon stage, which replaced the MPV eruption in winter 2005, is distinguished from previous gryphon stages by an unusually weak activity of small (although numerous) posteruptive gryphons. This is most likely explained by the exhaustion of the gas potential of the volcano during the eruption. As is well known, the gas potential is the major (or leading) factor of any active volcano or volcanism in general.

Thus, the extraordinary eruption of the MPV in winter 2005 is characterized by several specific features: unusual location and structure (stacking of flat bun-shaped lithoclastic fields on a swampy lowland); the presence of not one but several eruption centers; a heterogeneous and asynchronous character; different intensities of eruption; and so on. The virtual localization of all three centers on one line indicates their confinement to a common major fault zone. Numerous previous records of eruptions of this volcano suggest a distinct multirank periodicity of the process. One can distinguish at least two ranks. Low-rank eruptions occur with a periodicity of 1 or two years, whereas eruptions of the higher rank take place with a periodicity of several decades (~70 years if we take into consideration eruptions in 1934 and 2005). The beginning of the MPV eruption in winter 2005 with a vigorous gas burst undoubtedly indicates the major role of gas potential in the activity of any gas–water–lithoclastic volcano and volcanism in general.

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REFERENCES

1. A. Ya. Il'ev, S. M. Saprygin, and I. M. Siryk, Izv. Sakhalin. Otd. Geograf. O–va SSSR, No. 1, 92 (1970).
2. M. Isidzaki, *Report on Geological Investigation of the Mototomari Region* (1937) [in Japanese].
3. O. A. Mel'nikov, *The South-Sakhalin Gas–Water–Lithoclastic (Mud) Volcano as a Unique Object of Nature in the Russian Far East* (Yuzhno-Sakhalinsk, 2002) [in Russian].
4. O. A. Mel'nikov, A. V. Rybin, and R. V. Zharkov, in *Problems of the Development and Exploitation of the Raw Mineral Base of Sakhalin* (Yuzhno-Sakhalinsk, 2003) [in Russian].
5. O. A. Mel'nikov, K. F. Sergeev, A. V. Rybin, and R. V. Zharkov, Dokl. Earth Sci. **400**, 168 (2005) [Dokl. Akad. Nauk **400**, 536 (2005)].
6. I. M. Siryk and V. I. Fedorchenko, *Trudy SakhKNII Sib. Otd. Akad. Nauk SSSR,* No. 12, 103 (1962).
7. M. Ueda, *The Maguntan Mud Volcano* (1938) [in Japanese].
8. A. A. Yakubov, B. V. Grigor'yants, A. A. Aliev, et al., *Mud Volcanism in the Soviet Union and Its Relation to Petroleum Potential* (Elm, Baku, 1980) [in Russian].