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Late Cenozoic magmatism on the Wilhelm Archipelago, Graham Coast of the Antarctic Peninsula

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Manifestations of the recent magmatism were discovered in the Wilhelm Archipelago near the Ukrainian research station in the West Antarctica. There are small subvolcanic dykes that intrude Paleocene granitoids on the Barchans, Forge, Booth and Dannebrog Islands. The authors studied the occurrence, petrography and geochemistry of the dyke rocks in order to find out the peculiarities of their formation. The studied dykes are typical post-plutonic fissure intrusions injected in the host granitoids after their complete consolidation and cooling. Moreover, the host granitoids were not only cooled before the dyking but they were also exhumed at the beginning of the Neogene due to of the processes of tectonic uplift and erosion. Field observation and some other features point out to the Late Neogene or Quaternary age of the dykes. Their intrusion occurred at the shallow depths. During formation, at least part of the dykes was connected with the earth's surface. So, they were conduits for fissured volcanic eruptions. The geochemical features of the most widespread basaltic dykes call into question their genetic connection with quantitatively subordinate dykes of andesitic and dacitic composition. They probably had different sources of magma generation that were related to different geotectonic processes. Andesitic and dacitic dykes may represent the final outburst of subduction-related calc-alkaline magmatism. On the other hand, the connection between subduction processes and Late Cenozoic basaltic dyking is not obvious and requires additional research.

Keywords: *West Antarctica; geology; igneous rocks; mafic dykes.*

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Introduction

The Wilhelm Archipelago and the Argentine Islands, where the Ukrainian research station "Akademik Vernadsky" operates, are located on the sea shelf of the peripheral-continental orogenic belt of the Antarctic Peninsula (AP). Most of the AP consists of calc-alkaline igneous rocks which were formed by subduction of the oceanic lithosphere under the Pacific margin of the Gondwana supercontinent (Burton-Jonson and Riley, 2015). It is believed that the subduction processes and accompanying magmatism continued intermittently from Early Ordovician to the present time gradually stopping, first in the southern part of the AP and further north (Jordan et al., 2020). Currently, subduction occurs only along the northernmost edge of the AP in the area of the South Shetland Islands. As for the Wilhelm Archipelago, a significant part of the local igneous rocks was formed more than 54 Ma (Mytrokhyn et al., 2021). Although some manifestations of recent magmatism were still identified on the Archipelago and they are probably Late Cenozoic. Some of them appear in the Elliot (1964) under the names of "Post Andean" and "Tertiary" dykes of the Argentine Islands. But the vast majority of their outcrops were discovered by O. Mytrokhyn and V. Bakhmutov during geological survey in 2017, 2019 and 2020. All appearances of the recent magmatism are small subvolcanic dykes. They intruded into Paleocene granitoids after their complete consolidation and subsequent tectonic exhumation to the current erosion level. The geological position and petrography of the Late Cenozoic dykes of the Argentine islands were described in two previous publications by the authors (Mytrokhyn et al., 2022 a,b). *This article aims to characterize the mode of occurrence, petrography, major element geochemistry and probable formation conditions of all known manifestations of recent magmatism on the Wilhelm Archipelago.*

1. Geological setting

The Wilhelm Archipelago includes numerous individual islands and their groups that are scattered along the Graham Coast of the AP from the Bismarck Strait in the north to the Southwind Passage in the south. The Booth and the Hovgaard are the largest islands of the Archipelago. Its most prominent island groups are the Wauwermans, Dannebrog, Vedel, Roca, Cruls, Anagram and Argentine Islands. The AP mainland closest to the Archipelago is called Graham Coast. The latter forms a remarkable protrusion of land in this area which was recently named the Kyiv Peninsula.

The geological setting of the Wilhelm Archipelago and adjacent coast of the Kyiv Peninsula is shown in Fig. 1. Jurassic, Cretaceous and Paleogene igneous rocks are well exposed on numerous islands and neighbouring mainland coast of the Kyiv Peninsula. Most of them are products of subduction-related calc-alkaline magmatism. Due to the different depth of the erosion levels the volcanic, hypabyssal and plutonic rocks are exposed in different parts of the Archipelago. The oldest magmatic formations are considered to be the volcanogenic strata that exposed on the Argentine Islands and on the Kyiv Peninsula. Elliots (1964) and Curtis (1966) attributed them to the *Upper Jurassic Volcanic Group*. But Mytrolhyn and Bakhmutov (2019) correlate the volcanites with the Antarctic Peninsula Volcanic Group (APVG). The Jurassic-Cretaceous age of the Argentine Islands Formation (AIF) volcanites is determined by indirect data. Its lower age limit coincides with that adopted by Tomson and Pankhurst (1983) for APVG. The upper age limit is determined by Ar-Ar isotope dating of the Paleocene granitoids intruding AIF volcanites on the Barchans islands (Mytrokhyn and Bakhmutov, 2019). AIF is represented by unsorted lapilli tuffs, tuff breccias, pyroclastic breccias and andesite lava. Stratified ash tuffs, tuffites, sandstones, siltstones and cherts are subordinate. All volcanites and sedimentary rocks have undergone tectonic deformations, contact-thermal metamorphism and metasomatosis. The most intense metamorphic appearances were recorded beneath the contact zone of AIF with the Paleocene granodiorites on the Barchans and Forge Islands. In many places AIF is cross-cutted by mafic and intermediate dykes. The most ancient dykes of the Mesozoic age were subjected to metamorphism together with the host volcanites. Fewer Cenozoic dykes are almost unmetamorphosed. Some of them cross-cut not only AIF but also older Mesozoic dykes.

The plutonic rocks of the Wilhelm Archipelago occupy much larger areas than volcanites. Earlier they were described as *Andean Intrusive Suite* (Elliot, 1964; Curtis, 1966). Now, according

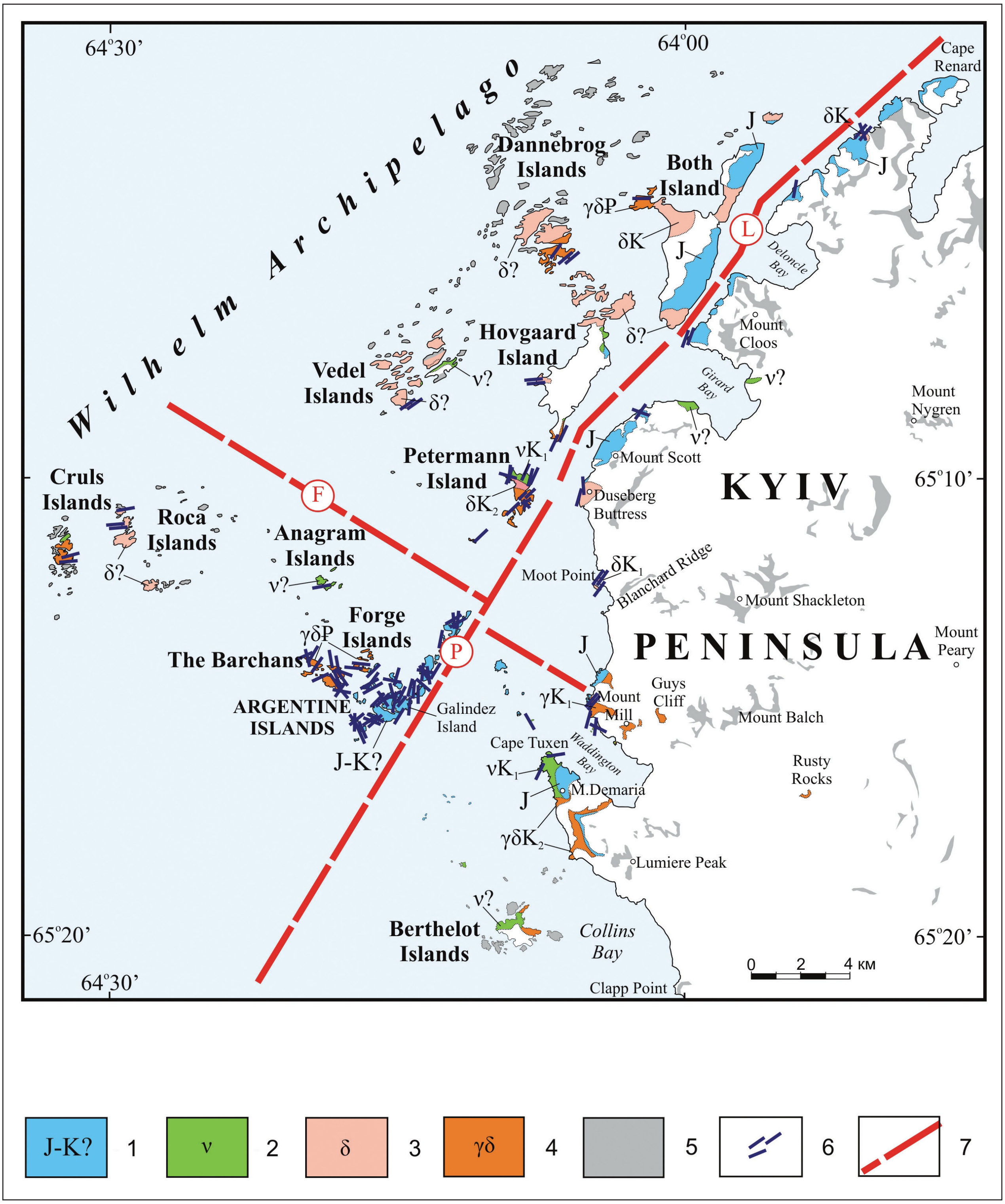

Fig. 1. Geological map of the Wilhelm Archipelago and adjacent coast of the Kyiv Peninsula according to (Mytrokhyn et al., 2022). Legend: *1* – volcanites of Kyiv Peninsula formation (J) and Argentine Islands formation (J-K); *2* – gabbroid intrusions of Early-Cretaceous (νK_1) and unknown (ν?) ages; *3* – diorite intrusions of Early-Cretaceous (δK_1) and unknown (δ?) ages; *4* – granitoid intrusions of Early-Cretaceous (γK1), Late Cretaceous ($\gamma\delta K_2$) and Palaeogene (γδP) ages; *5* – unidentified rock outcrops; *6* – mafic dykes of Cenozoic and Mesozoic age; *7* – regional faults in the Lemaire Channel (L), Penola Strait (P) and French Passage (F)

to Leat et al. (1995), numerous multiple-aged plutons of gabbroids, diorites and granitoids are considered to be parts of the Antarctic Peninsula batholith (APB).

Small gabbroid plutons are partly exposed on the Hovgaard, Petermann, Vedel, Anagram, Roca, Cruls and Berthelot islands as well as on the neighbouring mainland coastline in Girard Bay, Waddington Bay and Cape Tuxen. In many places gabbroids show fine primary-magmatic layering and cumulate textures. The present-day steep to vertical occurrence of the layering testify to tectonic deformations that occurred after the consolidation of layered gabbroids. Intrusive contacts of the gabbroids with Jurassic volcanites are exposed on Cape Tuxen and Hovgaard islands. On the Petermann Island the gabbroids themselves are intruded by Late Cretaceous tonalites with U-Pb isotope dating of zircons of 95,9±1 Ma (Bakhmutov et al., 2013). At least two age generations of post-plutonic mafic dykes intrude the gabbroids on the Petermann Islands.

Diorites and quartz diorites are the most widespread igneous rocks on the Wilhelm Archipelago. Their extensive outcrops are recorded on the Booth, Hovgaard, Dannebrog, Vedel and Roca Islands. Diorites were also found on the Duseberg Buttress, Moot Point and Waddington Bay of the Kyiv Peninsula. U-Pb isotope dating of zircons indicates the Early Cretaceous age of the diorites on the Moot Point (Tangeman et al., 1996). Paleocene age was recently obtained by U-Pb method for zircons from quartz diorite on the Booth Island (Zheng et al., 2018). However, these quartz diorites are intruded by granodiorites for which almost exactly the same Paleocene dating was obtained. The evidences of magmatic mingling were found by authors in many diorite outcrops. It indicates that their formation was accompanied by the simultaneous intrusions of the mafic and intermediate magma into the single chamber (Mytrokhyn et al., 2021). Post-plutonic mafic dykes intrude into the diorites on the Hovgaard and Roca islands.

Granitoids of the Wilhelm Archipelago are more widespread than gabbroids, but inferior to diorites and quartz diorites in this respect. They are located on the Booth, Dannebrog, Hovgaard, Vedel, Petermann, Anagram, Cruls, The Barchans, Forge and Berthelot islands. In addition numerous outcrops of granitoids were found on the Kyiv Peninsula in the area of Mount Demaria, Mount Mill, Guys Cliff and Rusty Rocks. U-Pb isotope dating of zircons provided the oldest age for the Early Cretaceous granites of the Rasmussen Island in the Waddington Bay of the Kyiv Peninsula (Tangeman et al., 1996). Late Cretaceous age was obtained for granodiorite on the Mount Demaria. Zircons from the granodiorite on the Booth Island yielded Paleocene value of U-Pb isotope age (Zheng et al., 2018). Rb-Sr, K-Ar and Ar-Ar isotope dating of the granodiorites on the Barchans and Forge Islands are also Paleocene (Rex 1976; Pankhurst, 1982; Bakhmutov et al., 2013). On the same islands granodiorites intrude Jurassic-Cretaceous strata of AIF. And on the Booth, Vedel and Roca Islands intrusive contacts of granitoids with older diorites were found. In many places granitoids also intrude in gabbroids. Numerous post-plutonic mafic and intermediate dykes cross-cut the granitoids on the Barchans, Forge, Cruls, Petermann, Vedel, Hovgaard, Dannebrog and Booth islands.

2. Mode of occurrence and petrography of the Late Cenozoic dykes

2.1. Subvolcanic dykes in the Paleocene granitoids on the Barchans islands

Locality 9A (65°14.500'S, 64°18.098'W) is on the northern coast of the Barchans-I island. The granodiorites are outcropped along the coastline in many places. They have a Paleocene age of 60,9±0,8 Ma according to Ar-Ar isotopic dating (Bakhmutov et al., 2013). Their K-Ar and Rb-Sr isotopic dating are also Paleocene but slightly younger, 56±2 Ma and 55±3 Ma, respectively (Rex, 1976; Pankhurst, 1982). 20 cm thick basaltic dyke intrudes the granodiorites (Fig. 2, *a*). It strikes to the north-west along azimuth of 335° and dips to the north-east at an angle 65°. The dyke is traced from the coast into the island at a distance of 15 m to the permanent snow and ice cowers. At one place the dyke is interrupted, but reappearing with a slight offset at a distance of 1 m. The contacts with the host granodiorites are sharp and straight. Near the borders of the dyke the endocontact chilled zones of black aphanitic rock are observed. Small angular xenoliths of granodiorite occur near the hanging contact. Dark gray porphyritic basalt

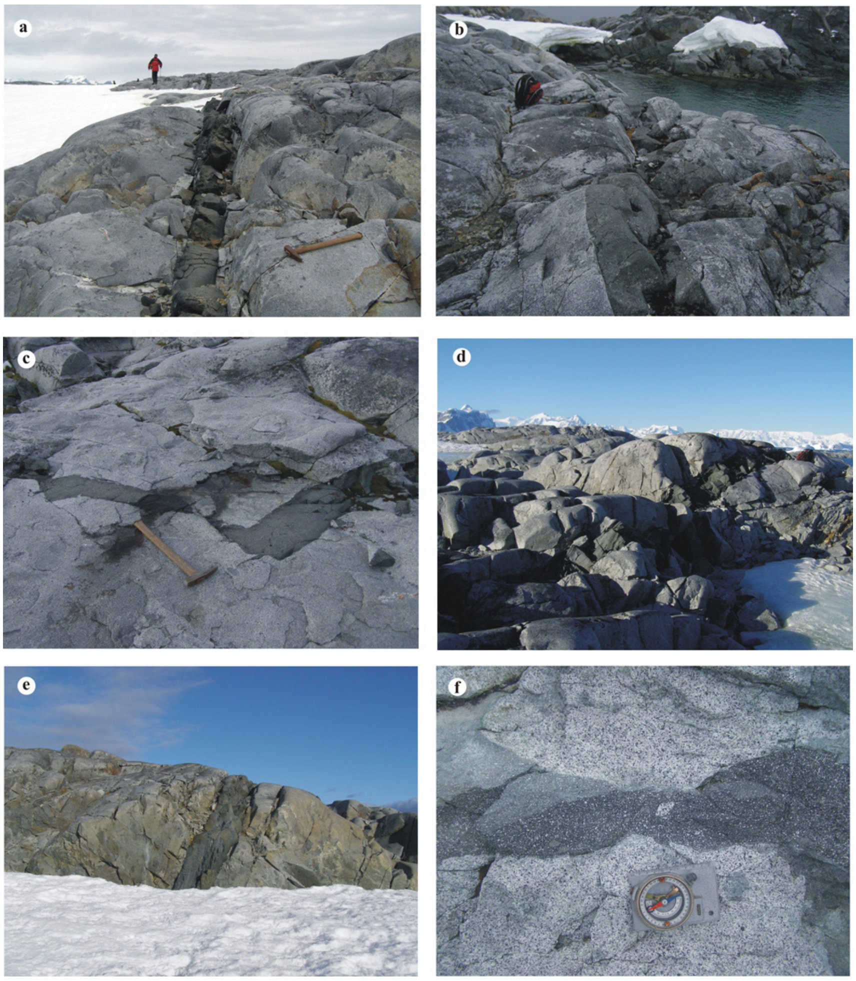

Fig. 2. Subvolcanic dykes in the Paleocene granitoids on the Barchans Islands: *a* – basaltic dyke of the Barchans-I Island, locality No. 9A; *b* – basaltic dyke of the Barchans-I Island, locality No. 10A; *c* – basaltic dyke of the Barchans-II Island, locality No. 38A; *d* – basaltic dyke of the Barchans-III Island, locality No. 123A; *e* – andesite dyke of the Barchans-III Island, locality No. 124A; *f* – dacite dyke of the Barchans-III Island, locality No. 265A

forms the inner part of the dyke. Plagioclase phenocrysts of 1–10 mm are concentrated near the axial zone. In thin section basalt shows fine-crystalline intergranular texture. A relic intersertal texture is identified in some areas. The primary volcanic glass is completely replaced by a microcrystalline aggregate of Fe-Mg mica and actinolite. The quantitatively subordinate clinopyroxene and magnetite microphenocrysts are also present with plagioclase phenocrysts. The studied basalt specimen also contains fritted xenocrysts of quartz. The groundmass consists of lath-shaped microliths of plagioclase, intergranular grains of clinopyroxene and magnetite as well as secondary Fe-Mg micas.

Locality 10A (65°14.490'S, 64°18.170'W) is on the northern coast of the Barchans-I island about 80 m north-west of the previous locality. Here the small basaltic dyke with a thickness of 25–45 cm intrudes the Paleocene granodiorite (Fig. 2, *b*). The dyke strikes to the north-west along azimuth of 325° with a dip of 55° to the north-east. The contacts with the host granitoids are sharp and straight, but signs of endocontact chilling are visually not as noticeable as in the previous dyke. Small granodiorite xenoliths are observed near the contact zone. The dyke is presented by dark gray porphyritic basalt. Few plagioclase phenocrysts of 1–4 mm are scattered in the aphanitic groundmass. In thin section the basalt demonstrates microcrystalline texture. As in the previous dyke, the volcanic glass is replaced by the aggregate of Fe-Mg micas and actinolite. But their content is noticeably higher, so the relic texture is defined as hyalopelite. This basalt is more altered compared to the previous dyke. Plagioclase phenocrysts and microliths as well as magnetite microliths have been preserved as primary minerals. Quartz xenocrysts also occur. Mafic minerals are completely replaced by actinolite and chlorite. Sphene is present in accessory quantities.

Fig. 3. Subvolcanic dykes in the Paleocene granitoids on the Forge Islands: *a* – basaltic dyke, locality No. 51A; *b* – basaltic dyke, locality No. 114A; *c* – basaltic dyke, locality No. 151A

Locality 38A (65°14.161'S, 64°18.442'S) is on the northern coast of the Barchans-II island. Paleocene granodiorites are intruded by a small basaltic dyke (Fig. 2, *c*), which is characterized by rather broken configuration. Its longer segments with a thickness of up to 50 cm strike along azimuth of 310° with a southwest dip at an angle 45°. They are connected by thinner segments with a north-western strike and north-eastern dip of 55°. The dyke is traced at a distance of about 35 m. Its boundaries with the host granodiorites are sharp with distinct aphanitic chilled zones. The dyke rock is dark gray porphyritic basalt with numerous plagioclase phenocrysts 1–3 mm in size. In thin section it can be seen that this basalt is less subject to post-magmatic replacements compared to the previous ones. It has fluidal texture due to the orientation of phenocrysts and microliths. Its texture is microcrystalline. The relic one is defined as hyalopelite. A significant part of the rock consists of an aggregate of Fe-Mg mica and actinolite which completely replaced the primary volcanic glass. Phenocrysts are represented by plagioclase, clinopyroxene and magnetite. The same minerals are identified among the microliths.

Locality 40A (65°14.191'S, 64°18.076'W), the northern coast of the Barchans-II island. Andesitic dyke with a thickness of 1.9–2.3 m intrudes into Paleocene granodiorites. The dyke strikes on the north-west along azimuth of 325–345° with the dip from vertical to north-east 65–85°. Contacts with the host granitoids are sharp and straight. The dyke discordantly cross-cuts thin quartz veins and zones of near-fracture hydrothermal alteration in the host granitoids. Endocontact chilled zones are represented by dark gray aphanitic rocks with small angular xenoliths of host rocks in some places. Moreower, the sporadic inclusions of leucocratic gabbroids of 1–10 cm are occured. In contrast to granitoid xenoliths, such inclusions are characterized by rounded or more elliptical shape. These inclusions are distributed throughout the body of dyke and partially are oriented parallel to general strike of the dyke. The dyke rock is fine mottled porphyritic andesite. Compared to the described above basaltic dykes the andesite is better crystallized due to the presence of numerous light gray plagioclase phenocrysts of 2–7 mm evenly dispersed in the greenish-gray aphanitic groundmass. A small number of mafic phenocrysts are poorly distinguishable against the dark general background. In thin section andesite shows a series-porphyry texture. Plagioclase phenocrysts vary considerably in size. In addition, the quantitatively subordinate phenocrysts of clinopyroxene and magnetite are observed. The groundmass is microcrystalline and has rather leucocratic composition. It consists of microliths of plagioclase and pyroxene as well as intergranular grains of magnetite. Any products of devitrification were not detected. The andesite is quite fresh but a small amount of secondary prehnite, chlorite, actinolite, epidote and sphene is associated with gabbroid microxenoliths.

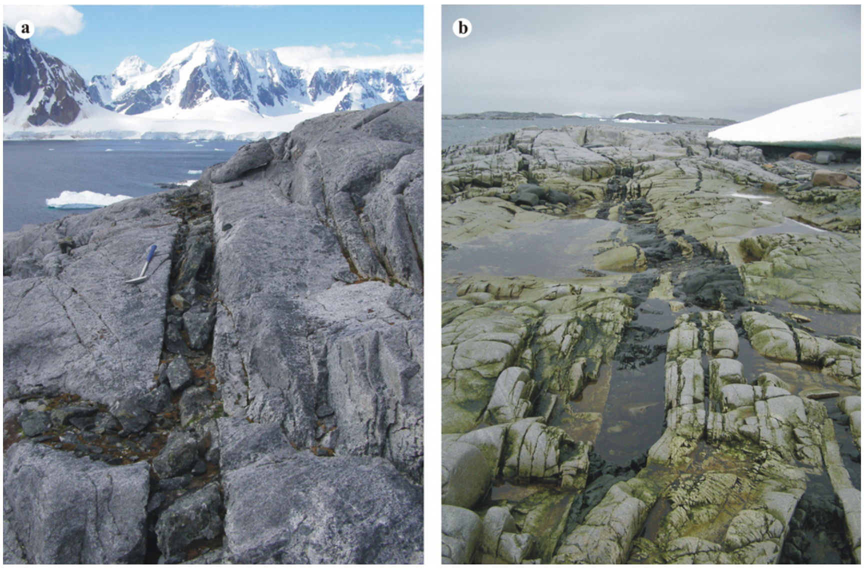

Fig. 4. Subvolcanic dykes in the Paleocene granitoids on the Booth and Dannebrog Islands: *a* – basaltic dyke of the Booth Island, locality No.129A; *b* – basaltic dykes of the Dannebrog Islands, locality No. 231A

Locality 123A (65°14.054'S, 64°19.700'W) is on the western part of the Barchans-III island. 55 cm thick basaltic dyke intrudes the Paleocene granodiorite (Fig. 2, *d*). The dyke was traced fragmentarily along its strike from the southern to the north-western coast of the island with broken configuration in some places. The general strike of the dyke is north-west 345° and dip 55° to the north-east. In one of the broken sections its longer and thicker north-western segments are connected with thinner and shorter segments with north-eastern strike and south-eastern dip of 75°. There are several smaller mafic dykes, probably apophysis, that are oriented parallel to the main dyke body. Both contacts of the dyke are sharp and chilled with aphanitic endocontact zones. The dyke rock is represented by greenish-gray basalt with fine grained groundmass containing single plagioclase phenocrysts 1–3 mm. In thin section the basalt shows a fine-crystalline texture. The groundmass consists of plagioclase laths in subophytic intergrowths with clinopyroxene and Fe-Ti oxides. There is some secondary mineralization. The clinopyroxene somewhere is partially replaced by actinolite. The appearance of secondary sphene is associated with Fe-Ti oxides. Primary volcanic glass is not recognized, but the products of its devitrification such as interstitial aggregates of chlorite are observed and impart to basalt a relic intersertal texture. In addition to single plagioclase phenocrysts, microxenoliths of altered gabbroids and pyroxenites with assosiation of secondary prehnite, actinolite, chlorite and epidote are detected.

Locality 124A (65°14.023'S, 64°19.576'W) is on the western part of the Barchans-III island. 1.7 m thick andesitic dyke is traced fragmentarily from the southern to the northern coast of the island at a distance of about 180 m in the Paleocene granodiorites (Fig. 2, *e*). The dyke strikes to the north-east along azimuth of 30° with dip 70° to the south-east. In one place its straight configuration is broken by a knee-like bend. The two main north-eastern segments of the dyke are joined by a smaller one that strikes to north-west with north-east dip at an angle 55°. Nearby the other andesitic dyke of 0,65 m thick is characterized by north-east strikes of 20° and dip of 65° to the south-east have the same composition. The contacts of the both dykes with the host rock are sharp with aphanitic chilled zones. The dykes are composed of greenish-gray porphyritic andesite with the similar lithology for the dyke described in locality 40A. In thin section the andesites show series porphytic texture with numerous plagioclase phenocrysts as well as quantitatively subordinate phenocrysts of clinopyroxene and magnetite. Their groundmass is microcrystalline and consisting of microliths of plagioclase and pyroxene as well as intergranular magnetite grains. Post-magmatic alteration is slightly developed. In some places the secondary actinolite replaces clinopyroxene.

Microxenoliths of gabbroids in andesite are also replaced by secondary prehnite, actinolite, chlorite, epidote and sphene.

Locality 265A (65°14.111'S 64°19.154'W) is the eastern part of the Barchans-III island. Paleocene granodiorites are intruded by dacitic dyke (Fig. 2, *f*). It differs from all mentioned above dykes in rather unstable thickness from 20–25 cm in swell to 2–5 cm in incompression parts. The dyke is appeared from the snow cover in the southwest, traced at a distance of 50 m and interrupted in the north-east on the island coast line. The dyke strikes to the north-west along azimuth 345° and dips to the north-east at an angle 55°. Its contacts with the host granitoids are sharp and predominantly rectilinear with local wavy configuration and apophysis in some segments. The internal structure of the dyke is zoned with a slightly lighter inner part and darker aphanitic endocontact chilled zones of variable thickness. The dark gray colour of this dacite is unusual for felsic rock. Lighter plagioclase phenocrysts in a dark aphanitic groundmass provide the porphyritic texture to the dacite. Visually the dacite can be mistaken for andesite or basaltic andesite. Plagioclase phenocrysts of 2–4 mm are unevenly distributed with content increases to 25–30 %, in some area and decreases to 10–15 % in other. In addition to plagioclase phenocrysts the dacite contains small rock inclusions of microdiorite. In thin section the dacite shows series-porphyry texture with felsitic groundmass. The sizes of plagioclase phenocrysts vary significantly. Primary mafic phenocrysts are absent, but there are peculiar aggregates of chlorite with inclusions of epidote and sphene which may be pseudomorphoses from Fe-Mg mica or hornblende. Apart from them, there are single idiomorphic or subidiomorphic grains of sphene. The fluidal structure of the dacite is determined both by the orientation of the phenocrysts and by striation in the felsitic groundmass with alternation of winding streaks-streams which differ in the content of dust-like inclusions of mafic minerals and, accordingly, in the color tone by plane polarized light. The relic texture of the dacite is defined as vitrophyric. The felsitic material that makes up its groundmass is a devitrification product of acidic volcanic glass. It consists of a microcrystalline aggregate of quartz and feldspars with heterogeneously scattered microscopic flakes of Fe-Mg mica and chlorite.

2.2. Subvolcanic dykes in the Paleocene granitoids on the Forge Islands

Locality 51A (65°14.147'S, 64°16.809'W) is the northern coast of the largest among the Forge Islands. Granodiorites of Paleocene age are exposed in this and many other places. Their K-Ar isotopic dating gave an age of 54±2 Ma (Rex, 1976). The granodiorites are intruded by two parallel basaltic dykes. The wider from them is 45 cm thick dyke. It intermittently traced from east to west at a distance of 15 m (Fig. 3, *a*). The dyke strikes along azimuth 260° and dips to the north at an angle 70°. Dyke body is slightly displaced in one place and on another it is completely torn across in other. In the latter case, both disconnected segments end in narrow wedge-shaped apophysis cutting into the host granitoids. Dyke contacts are sharp with chilled aphanitic endocontact zones. There are several granodiorite xenoliths less than 1 cm in size near the hanging endocontact. Another thinner dyke with the same strike and dip is located at a distance of 3 m from larger one. It was possible to trace it at a distance of 50 m. The thickness of this dyke gradually decreases and it is completely wedged out in the eastern direction. The basalt of wider dyke is greenish-gray aphanitic rock. In thin section it is subjected to intense post-magmatic alteration with the development of secondary potash feldspar, calcite, chlorite and prehnite. However, the dyke rock preserves its microporphyritic and amygdaloidal textures. Phenocrysts are represented by plagioclase and clinopyroxene. Plagioclase phenocrysts are partially replaced by potash feldspar. Phenocrysts of some mafic mineral, possibly olivine, are completely replaced by calcite. Microscopic amygdules which consist of calcite and chlorite are especially numerous in the endocontact zones of the dyke. The groundmass of the basalts shows microcrystalline texture. It consists of plagioclase microliths as well as intergranular grains of clinopyroxene and Fe-Ti oxides. Secondary chlorite fills some interstices and probably completely replaces the volcanic glass. Relic texture of the basalt is identified as intersertal one. Secondary prehnite develops on some plagioclases. Prehnite also crystallizes in microscopic cracks that cross the studied basalt.

Locality 114A (65°14.093'S, 64°16.972'W) is the northern coast of the largest among the Forge Islands. Paleocene granodiorites are cross-cut by aplite vein and an even later basaltic dyke (Fig. 3, *b*). The rectilinear aplite vein of 4 cm thick with sharp parallel contacts does not show the noticeable near-contact changes. The vein strikes to the north-east along azimuth of 70° with dip of 85° to the southeast. 1-m basaltic dyke intrudes both the host granodiorite and the aplite vein. The dyke traced intermittently from west to east at a distance of 160 m. Its strike is 275° with vertical dip. The basalt is a greenish-gray porphyritic rock which better crystallized compared to the basalt dykes in locality 51A. Numerous phenocrysts of light gray feldspar are scattered in the aphanitic groundmass. A fluidal texture is well observed in thin section due to parallel orientation of the phenocrysts. The phenocrysts are represented by plagioclase and quantitatively subordinate clinopyroxene. Secondary potash feldspar partially replaces plagioclase phenocrysts. Amygdaloidal texture is also detected in thin section. Microscopic amygdules are filled by chlorite. The groundmass is microcrystalline and consists of lath-shaped microliths of feldspar between which intergranular grains of clinopyroxene and Fe-Ti oxides were crystallized. Secondary chlorite fills the interstices. It completely replaced the volcanic glass showing the relic intersertal texture. In addition to chlorite the development of secondary potash feldspar, prehnite, calcite and epidote are notable in the groundmass of the basalt.

Locality 151A (65°14.142'S, 64°17.340'W) is on the north-western coast of the largest among the Forge Islands. Paleocene granodiorites are intruded by three parallel basaltic dykes striking in sublatitudinal direction of 275° with the thicknesses of 27, 56 and 90 cm. The dykes also cross-cut thin quartz veins with molybdenite mineralization that develop in the granitoids in this area. The thinnest of the dykes dips in the northern direction at an angle 75° and looks more altered due to typical greenish color. The thickest dyke dips vertically (Fig. 3c). Its rectilinear configuration is broken by stepped bend and a thin apophysis in one place. The apophysis of 10 cm is gradually wedges out in the eastern direction. The basalt in the apothysis also looks more altered compared to the main dyke body. The contacts of the thickest dyke are sharp with black aphanitic chilled zones up to 2 cm thick. In general, the dyke rock is dark gray and at first glance appears to be fine-grained. But with magnifying glass you can see that it has a fine porphyritic texture. Numerous of 1-mm feldspar phenocrysts are embedded in the aphanitic groundmass with more concentration in the axial part of the dyke. Examination in thin section showed that the phenocrysts are plagioclase partly replaced by potash feldspar. The quantitatively subordinate clinopyroxene phenocrysts are present as well. The fine-crystalline groundmass consists of feldspar microliths, intergranular clinopyroxene and Fe-Ti oxides. The relic intersertal texture is determined by the presence of interstitial chlorite aggregates which are probably the secondary product of volcanic glass replacement. Secondary calcite and prehnite are less developed compared to similar basalt dykes in two previous localities on the Forge Islands.

2.3. Subvolcanic dykes in the Paleocene granitoids on the Booth and Dannebrog Islands

Locality 129A (65°3.896'S, 64°2.119'W) is at the extremity of a long cape on the west coast of the Booth Island. Paleocene granodiorites make up a remarkable hill with a commemorative sigh in honour of the Charcot expedition. U-Pb isotopic age of zircons from these granodiorites is 61,6±0,5 Ma (Zheng et al., 2018). Granodiotite is intruded by 25 cm thick basaltic dyke located about 20 m to the north-east from the commemorative sign (Fig. 4, *a*). The dyke strikes along azimuth 90° and its dip is vertical. It is appeared on the distance of 20 m. There is another small dyke in close vicinity, but it is much worse exposed. The main dyke is composed by dark greenish-gray aphanitic basalt which is remarkably expressed by dark colour and in relief against the background of the host light-gray granodiorites. Unfortunatly the contacts and body of dyke were not outcropped well which does not allow to study in detail. In thin section the basalt shows microporphyriric texture. Sparce phenocrysts are represented by plagioclase and clinopyroxene. The chlorite pseudomorphs on phenocrysts of an unidentified mafic mineral, probably olivine, are more common Groundmass is microcrystalline. Plagioclase lath-shaped microliths somewhere show fluidal orientation. Intergranular grains of clinopyroxene and Fe-Ti oxides are located in the spaces between the plagioclase laths. Besides the chlorite a small amount of secondary calcite is presented in the groundmass.

Table 1. **XRF analyses of the slightly- to moderately altered dyke rocks of the Argentine Islands**

Sample	**84A-2**	**93A-3**	**123A-1**	**10A-1**	**9A-2**	**38A-1**	**124A-3**	**124A-2**	**40A-1**	**12-1**	**12-2**
Location	**Galindez**		**The Barchans**								
Rock	Basalt	Basalt	Basalt	Basalt	Basalt	Basalt	Andesite	Andesite	Andesite	Dacite	Dacite
Weight percents. %											
SiO_2	46.42	47.46	50.45	50.89	51.50	51.70	54.45	56.76	57.08	65.26	67.87
TiO_2	0.98	0.95	0.84	0.72	0.69	0.67	0.81	0.86	0.84	0.55	0.55
Al_2O_3	18.83	17.52	17.21	16.01	16.20	16.03	15.60	16.81	16.23	13.93	14.01
Fe_2O_3	9.68	9.15	8.96	9.60	8.54	8.05	8.01	8.37	7.85	4.85	3.77
MnO	0.16	0.18	0.28	0.41	0.21	0.25	0.16	0.17	0.13	0.08	0.07
MgO	8.00	8.65	6.72	7.57	7.33	7.66	3.79	3.46	3.91	2.09	1.96
CaO	10.15	9.24	10.04	8.02	8.95	8.90	5.93	6.93	6.79	3.55	3.84
Na_2O	2.04	2.54	2.06	1.99	2.09	2.08	3.45	3.59	3.48	2.98	3.87
K_2O	0.69	0.38	0.66	2.04	1.87	2.26	1.15	1.12	0.89	2.56	1.03
P_2O_5	0.18	0.22	0.12	0.13	0.12	0.12	0.15	0.19	0.14	0.14	0.14
LOI	2.50	3.40	2.40	2.30	2.20	1.90	2.40	1.50	1.24	1.78	1.25
Sum	99.63	99.69	99.74	99.68	99.70	99.62	95.90	99.76	98.58	97.77	98.36
CIPW norm calculation											
Quartz	–	–	2.66	–	0.45	–	10.32	10.18	12.14	27.8	31.1
Plagioclase	65.14	65.2	60.19	51.64	52.9	50.74	60.9	62.17	61.24	45.13	53.68
Orthoclase	4.93	2.74	4.65	14.42	13.12	15.79	8.2	7.6	6.08	17.03	6.71
Diopside	6.76	6.94	9.97	7.68	10.67	11.59	3.62	4.85	4.9	–	0.26
Hypersthene	9.46	13.02	20.47	23.55	21.05	18.61	14.6	12.77	13.37	8.22	6.75
Olivine	11.26	9.62	–	0.72	–	1.52	–	–	–	–	–
Ilmenite	1.21	1.19	1.03	0.89	0.84	0.81	1	1.01	1	0.64	0.62
Magnetite	0.84	0.79	0.77	0.82	0.72	0.68	1.03	1.03	0.97	0.78	0.6
Apatite	0.41	0.49	0.26	0.28	0.26	0.26	0.33	0.39	0.29	0.3	0.28

Locality 231A (65°5.203'S, 64°6.350'W) is on the northern coast of an unnamed island from the Dannebrog group. It is separated from the above-described cape on the Booth Island by 3.5 km wide sea strait. Numerous outcrops of granodiorites are recorded on this island as well as on the neighbouring Elizabeth Island. According to the results of field observation we assume that a single granodiorite pluton of Paleocene age is fragmentally exposed on the Booth and Dannebrog islands. In the studied locality granodiorites are intruded by a dense swarm of mafic dykes (Fig**.** 4, *b*). The dyke swarm is oriented in the north-eastern direction parallel to the main system of cracks in the host granitoids. The largest of the dyke is 60 cm thick. It strikes along azimuth of 50° with subvertical dip. The dyke consists of greenish-gray basalt with microscopic inclusions of plutonic ultramafic rocks. In thin section these inclusions are composed of altered pyroxenite. The basalt itself reveals a microcrystalline texture. The phenocrysts are only mafic mineral among which clinopyroxene prevails. Deformed phenocrysts of brown hornblende are less common. There are complete pseudomorphoses on another mafic mineral consisting of carbonate and epidote. The groundmass is micro-

Table 2. **XRF analyses of the intensively altered dyke rocks of the Argentine Islands**

Sample	51A-2	114A-2	51A-1	6-1	6-3	6-4	6-5
Location	**Forge Islands**			**The Barchans**			
Rock	Basalt	Basalt	Basalt	Basalt	Basalt	Basalt	Basalt
Weight percents, %							
SiO_2	42.74	44.24	44.52	42.41	42.74	44.58	44.91
TiO_2	0.88	0.87	0.86	0.84	0.85	0.87	0.86
Al_2O_3	17.12	17.19	16.70	15.07	14.58	15.48	15.42
Fe_2O_3	10.17	9.87	9.81	9.5	9.27	9.54	9.32
MnO	0.17	0.16	0.15	0.2	0.24	0.19	0.20
MgO	7.38	7.25	7.49	7.5	8.05	7.70	7.64
CaO	7.93	8.70	7.24	7.21	6.68	7.84	7.57
Na_2O	3.51	3.17	2.95	2.45	2.60	2.47	2.40
K_2O	0.88	1.20	2.05	2.72	1.97	1.90	2.08
P_2O_5	0.13	0.11	0.12	0.18	0.18	0.23	0.24
LOI	5.02	3.65	4.22	6.63	6.99	5.26	5.26
Sum	95.92	96.41	96.1	94.71	94.15	96.06	95.90
CIPW norm calculation							
Plagioclase	57.07	56.14	52.78	41.71	52.23	55.25	55.15
Orthoclase	6.61	8.85	15.21	21.17	15.5	14.35	15.73
Nepheline	7.67	5.88	4.74	6.62	2.2	0.65	–
Diopside	8.16	10.45	7	10.32	8.02	9.41	8.71
Hypersthene	–	–	–	–	–	–	0.61
Olivine	18.11	16.44	18.01	17.71	19.58	17.77	17.27
Ilmenite	1.16	1.12	1.11	1.13	1.15	1.14	1.13
Magnetite	0.93	0.88	0.88	0.89	0.88	0.87	0.85
Apatite	0.3	0.26	0.28	0.45	0.45	0.55	0.55

Note: Samples 6-1, 6-3, 6-4, 6-5 were provided to the authors by P. Burtniy, who collected them in 2004 from a basaltic dyke intruding granodiorites on the island Barchans-IV, 65°14.28'S, 64°19.84'W. These basalts are petrographically similar to the author's samples of intensely altered dyke rocks from the Forge Islands. High values of LOI in them are caused by significant development of secondary calcite and chlorite. The increased potassium alkalinity is explained by the development of secondary potash feldspar.

crystalline with vague signs of fluidal texture emphasized by orientation of microliths of plagioclase and hornblende. Tiny grains of clinopyroxene and Fe-Ti oxides as well as secondary calcite and chlorite fill the intergranular space.

Locality 232A (65°5.057'S, 64°6.805'W) is on the central part of the same unnamed islands from the Dannebrog group. Granodiorites are exposed on the top and slopes of the remarkable hill which altitude is of 34 m above sea level. The granodiorites are intruded by an andesitic dyke of 3.8 m thick. The dyke strikes to the north-east along azimuth of 35° with vertical dip. It looks intensely altered with a numerous cracks and pieces of crushed andesites on the surface. In relief the dyke appears as a long slit-like depression traced at a distance of 20 m.

The andesite is a greenish-gray porphyritic rock with a numerous phenocrysts of altered plagioclase immersed into the aphanitic groundmass. The plagioclase phenocrysts are differently replaced by calcite and prehnite.

2.4. Subvolcanic dykes in the volcanites on the Galindez Island

Some of the dykes in the Argentine Island volcanites are petrographically similar to the basaltic dykes intruding Paleocene granitoids on the Barchans. These dykes also intrude sill-like microdiorite of Cretaceous age as well as they cross-cut some other dyke bodies on the Galindez Island. Therefore, we consider them to be among the youngest intrusive formations on the Argentine Islands.

Locality 84A (65°14.967'S, 64°15.235'W) is on the western coast of the Galindez Island. The low sloping hill consists of microdiorites which form a large sill-like intrusion in the volcanites of AIF. A subhorisontal intrusive contact of microdiorites with overlying lapilli tuffs is exposed to the east of the locality and to the north on the other side of a small inlet. Near the north-western and southern foothills, the lapilli tuffs underlie the microdiorite intrusion. Vertical thickness of the intrusion exceeds 5 m, the lower contact is under snow and debris of weathering rocks. The microdiorites become finer-grained and acquire the porphyritic texture in approaching to likely location of the contact. The microdiorites themselves are intruded by later basaltic dyke of 0.45 cm thick with strike 10° and vertical dip. The dyke rock is dark gray aphanitic basalt with small amount of plagioclase phenocrysts of 2–3 cm in size. Beside of visible plagioclase phenocrysts the microscopic phenocrysts are observed in thin section. Mafic phenocrysts are not observed, but their pseudomorphoses by actinolite and talc. Beside them the microscopic fragments of altered gabbroids are stand out somewhere. The groundmass of basalt is fine crystalline and fluidal. It consists of oriented microliths of plagioclase, intergranular grains of clinopyroxene and Fe-Ti oxides. The original volcanic glass is completely replaced by secondary chlorite which fills the interstices between plagioclase microliths revealing the relic intersertal texture.

Locality 93A (65°14.853'S, 64°14.616'W) is on the northern coast of the Galindez Island. There is the sill-like microdiorite intrusion which petrographically is similar to described above. The lower contact of intrusion is under water and to estimate its vertical thickness is impossible. The inclined intrusive contact with the overlying volcanites of AIF is exposed fragmentarily in several areas. Toward the contact with lapilli tuff the grain sizes of microdiorite noticeably decreases, but fracturing increases with acquisition of thin-tiled jointing. The aphanitic chilled zone in the vicinity to endocontact is well detected. As in locality 84A the geological age of microdiorite belong to Cretaceous. The microdiorite intrusion is crossed by two dykes of different ages. The youngest dyke crosses not only the microdiorite and local lapilli tuffs, but also another older dyke. The youngest basaltic dyke is 40 cm thick. It lies vertically and strikes in the north-east direction along azimuth of 37°. Contacts with the host rocks are sharp and slightly winding with some aphanitic chilled zones of 1–2 cm. The dyke is characterized by zonal structure with 5–10 cm strips of different colour tones oriented toward to general strike of the dyke. The dyke rock is greenish-gray porphyritic basalt. The plagioclase phenocrysts of 1–3 mm are poorly distinguishable against of the aphanitic groundmass. In thin section the basalt looks less crystallized than in 84A locality. Its texture is microcrystalline with isolated plagioclase phenocrysts. The phenocrysts of mafic minerals are completely replaced by actinolite and epidote. The groundmass consists of plagioclase microliths, intergranular grains of clinopyroxene and Fe-Ti oxides. Products of devitrification of volcanic glass were not detected.

3. Geochemistry of Late Cenozoic dykes

The content of major oxides in representative samples of studied dyke rocks is illustrated by Tables 1–2 and Figures 5–9. First of all we pay attention to significant variations in loss on ignition (LOI) indicating an extremely heterogeneous degree of low-temperature post-magmatic alteration. LOI usually not exceed 2 % in weakly altered sample of the dyke rocks. In moderately altered ones LOI are 2–3.5 %, and in strongly altered samples the LOI ranges from 3.7 to 7 % (see Table 2). According to recommendations of the Le Maitr et al., 2002, all XRF analyses were converted to "dry" residue before being presented on classification diagrams. Despite this, almost all strongly altered samples on the TAS diagram are

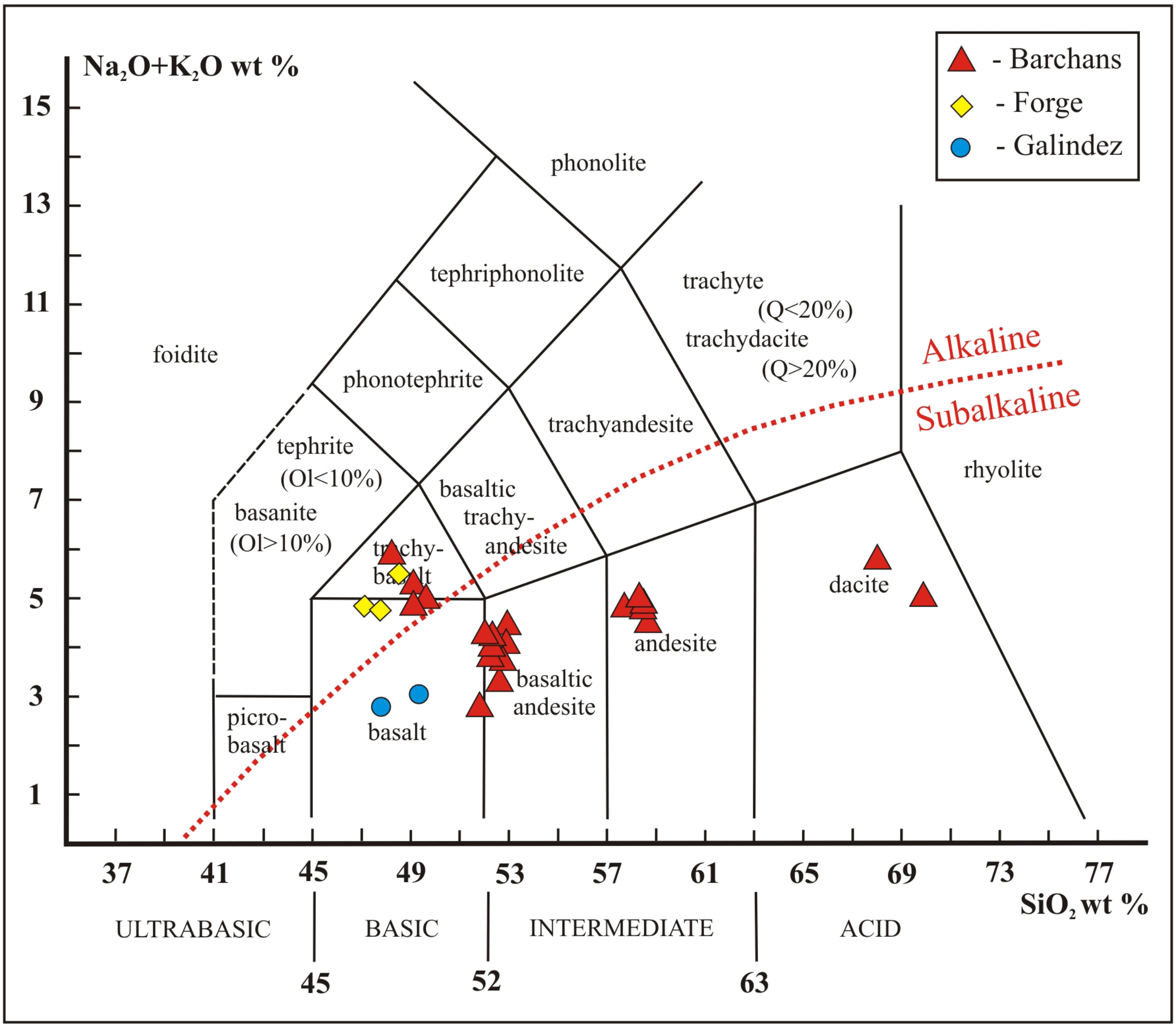

Fig. 5. Late Cenozoic dykes of the Argentine Islands on the TAS diagram. Classification fields are drawn according to recommendation of IUGS (Le Maitr et al., 2002). The dotted line represents the boundary between the alkaline and subalkaline series, according to Rickwood, 1989. Primary analytical data are given in Tables 1 and 2. All XRF analyses were converted to an anhydrous basis before plotting on the diagram

separated from less altered ones, falling onto the classification field of alkaline volcanites (Fig. 5). In particular, all strongly altered basaltic dykes of the Forge Islands and several basaltic dykes of The Barchans islands fell into the alkaline field. Recalculation by the CIPW method showed that the normative nepheline content in these rocks is a moderate 0.7–7.7 %. The foids are not found in their modal composition, but alkaline feldspars probably by post-magmatic origin are present. On the SiO_2-K_2O diagram the "alkaline" dykes do not form a single grouping (Fig. 6). Most are within the trachybasalts classification field of shoshonite series. But two dykes from Forge Islands belong to basalts of calc-alkaline series. In general, development of secondary albite and potassic feldspar can explain the increased alkalinity of some dyke rocks, but no way to explain the silica undersaturation that appears in the CIPW calculation. If beside of alkali feldspars the secondary mineralization includes calcite and chlorite, then the CIPW calculation can give normative foids. Note that alkaline mafic minerals are not detected in the modal composition of "alkaline" dykes. Low concentrations of Nb as well as the moderate contents of TiO_2 and P_2O_5 are also not consistent with the high content of alkalis in the most altered samples. Taking into account these notes the increased alkalinity of these samples is due to post-magmatic alterations.

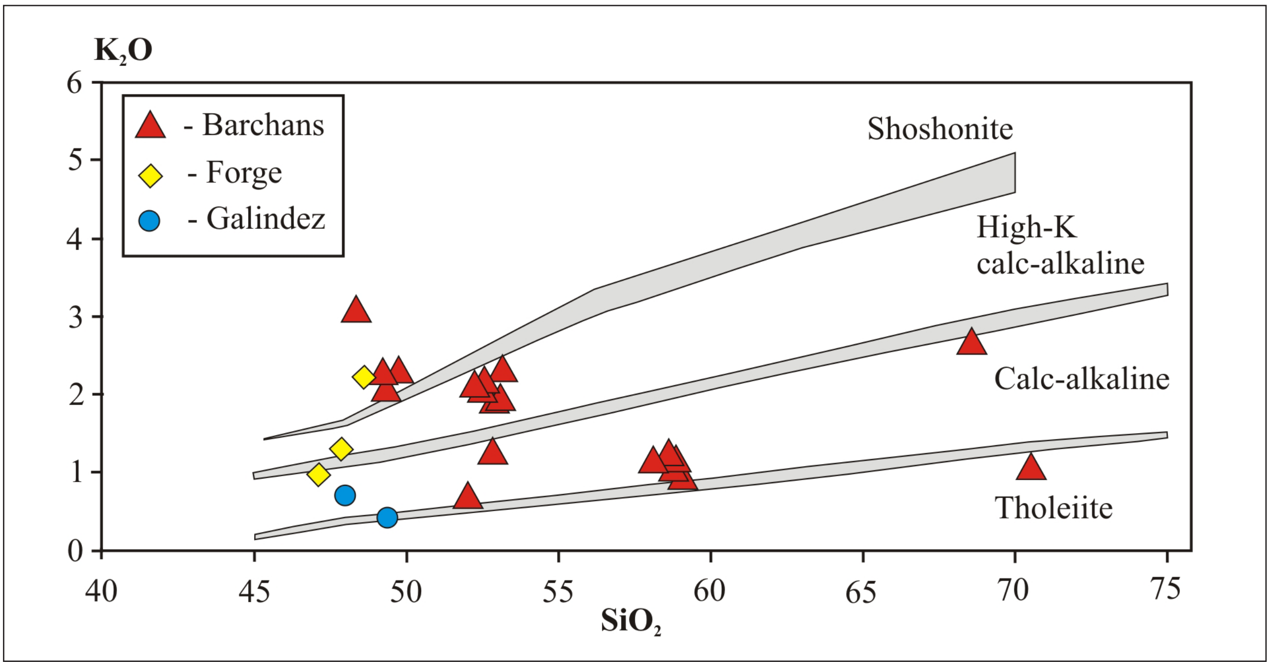

Fig. 6. Late Cenozoic dykes of the Argentine Islands on SiO_2 – K_2O diagram. Classification fields are drawn according to Rickwood, 1989. Primary analytical data are given in Tables 1 and 2. All XRF analyses were converted to an anhydrous basis before plotting on the diagram

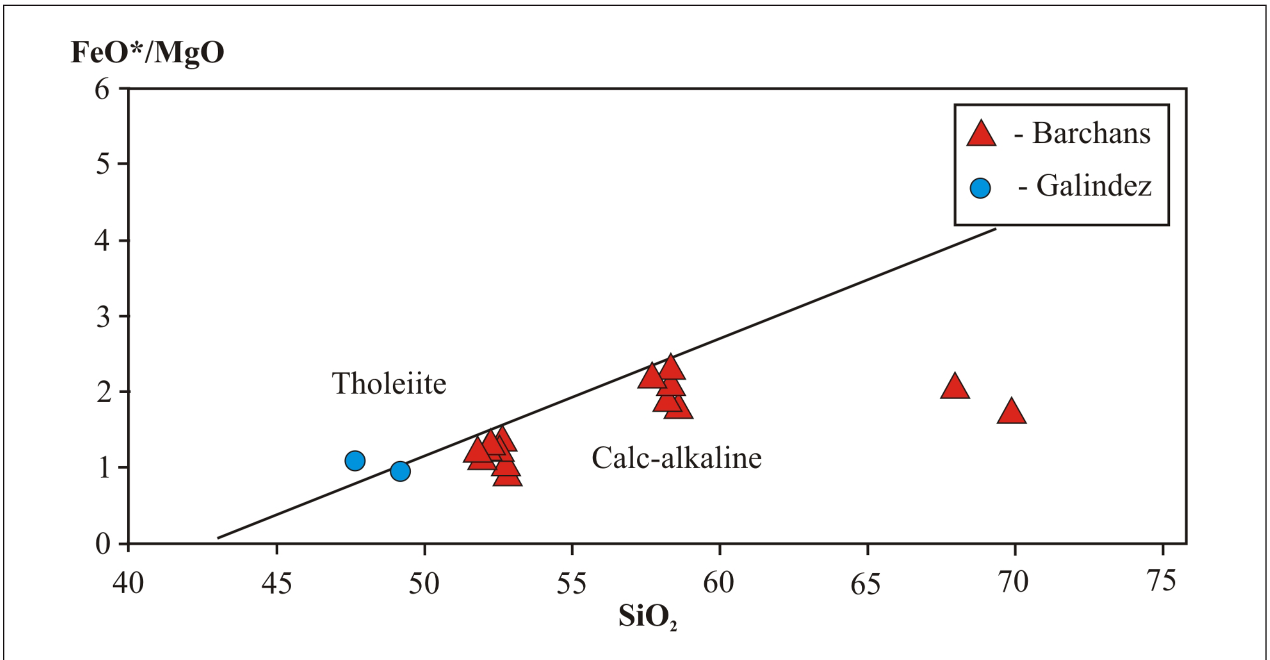

Fig. 7. Late Cenozoic dykes of the Argentine Islands on SiO_2 – FeO*/MgO diagram. Classification fields are drawn according to Rickwood, 1989. Primary analytical data are given in Tables 1. XRF analyses were converted to an anhydrous basis before plotting on the diagram

In order to avoid the impact of these alrerations on the geochemical characteristics the data on the most altered samples were not used in subsequent analyses.

The rest of the samples on the TAS diagram were divided into four discrete groups differed by SiO_2 content. These are basalts, basaltic andesites, andesites and dacites.

Two basaltic dykes on the Galindez Island show the lowest SiO_2 content. The presence of 10–11 % of olivine in CIPW norms indicates silica undersaturation of their parent magma. We consider these dykes to the most primitive differentiates of Late Cenozoic magmatism in this area taking into account the highest values of the *mg* coefficient (MgO/MgO+FeO*) and the highest concentrations of Cr and Ni. This is confirmed by the lowest content of K and other LIL elements. Simultaneously the concentrations of most HFS elements are close to those typical for MORB, or even lower. Nevertheless, the concentrations of Th and Ce are significantly higher than in MORB, and the concentrations of Nb and Ta are significantly lower. So, the normalization to the composition of MORB revealed deep negative anomalies of Nb and Ta. The total content of REE is 20–22 times higher than that of chondrites, with a noticeable predominance of light lanthanides over heavy ones.

Most basaltic dykes on the Barchans islands are characterized by a significantly higher SiO_2 content than the Galindez ones. Recalculation to anhydrous basis belong their values in classification field of the intermediate rocks (basaltic andesite). CIPW norm calculations show small amount of normative quartz in the most of these samples. So, they are slightly oversaturated with silica. Some olivine-normative samples contain a noticeable amount of hypersthene in CIPW norm indicating only a minor undersaturation with silica. The *mg* coefficient and Cr content in the Barchans basaltic dykes are only slightly lower than in the most magnesian dyke of the Galindez Island. But Ni concentrations are significantly lower. Compared to Galindez basaltic dikes, they are characterized by significantly greater enrichment of LIL elements, notably K and Rb, as well as deeper negative anomalies of Nb and Ta. The total content of REE is the same or slightly lower, the level of enrichment with light lanthanides is slightly lower. Two of the four Barchans basaltic dykes revealed a weak negative europium anomaly.

Andesitic dykes from the Barchans islands are significantly separated from basaltic ones by higher SiO_2 content. They naturally fell into the classification field of intermediate volcanic rocks. Their supersaturation with silica is evidence from more than 10 % of the normative quartz in the CIPW calculation. It is confirmed by small values of the *mg* coefficient as well as low concentrations of Cr and Ni. It is somewhat unusual that the K and Rb contents in the andesitic dykes are lower than in the more basic dykes from the Barchans, while the concentrations of Ba, Sr, and HFS elements, on the contrary, are higher. The total content of REE is the highest among the all studied samples. Andesitic dykes are similar to some basaltic dykes of the Barchans islands by their

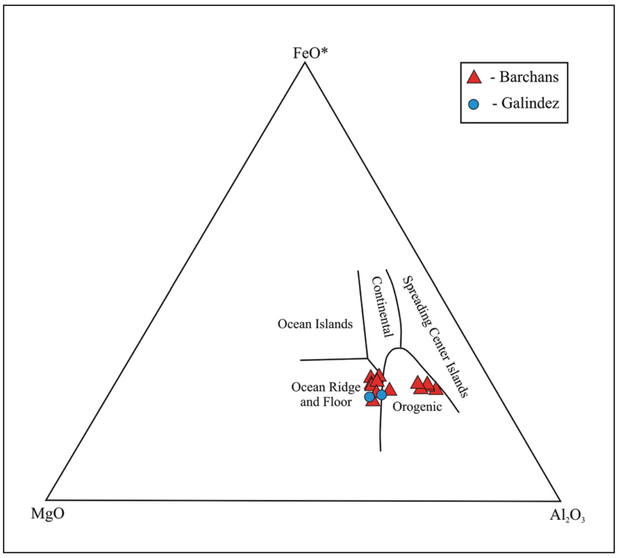

Fig. 8. Late Cenozoic dykes of the Argentine Islands on Al_2O_3 – MgO – FeO* diagram. Classification fields are drawn according to Pearce, 1977. Primary analytical data are given in Table 1

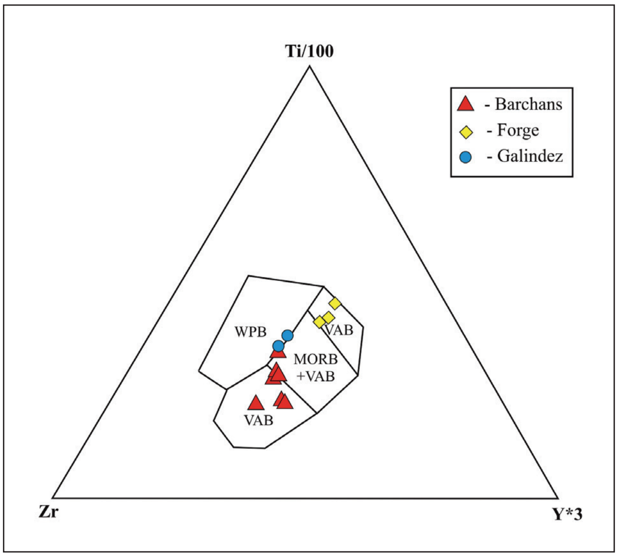

Fig. 9. Late Cenozoic dykes of the Argentine Islands on Y – Zr – Ti diagram. Classification fields are drawn according to Pearce, 1996

moderate level of enrichment in light lanthanides compared to heavy lanthanides, as well as a weak negative europium anomaly.

Dacitic dyke samples from the Barchans have the highest SiO_2 content and belong to classification field of acidic rocks on the TAS diagram. Maximum supersaturation with silica is confirmed by 28–31 % of normative quartz in CIPW calculations. Accordingly, the content of Fe_2O_3, MgO and CaO is minimal, although the *mg* coefficient does not fundamentally differ from that of andesites. Ni and Cr are near the limit of detection by XRF analysis. Concentrations of LIL elements are intermediate between those found in basalts and andesites. But individual HFS elements are characterized by maximum concentration values.

The classification diagrams for attribution of volcanites to some petrochemical series and their geotectonic position does not have the unambiguous result for the studied dyke rocks (Fig. 6–9).

4. Discussion

Small subvolcanic dykes that intrude Paleocene granitoids of the Wilhelm Archipelago represent the youngest manifestation of magmatism in the area of the Ukrainian Antarctic station and deserve the more attention of geologists. New mapping of dykes on the Booth and Dannebrog Islands significantly expands their distribution area on the much larger territories. Our field investigations and data analyses suggest that the subvolcanic dykes swarms of NE and WE trend in granitoids and diorites on the Vedel, Hovgaard, Petermann, Roca and Cruls Islands belong to recent magmatic formations. Besides of common strike they have the same petrographic features.

What is known about the intrusive age of the investigated dykes? Their isotopic dating has not yet been performed and this gap in geochronological data should be solved in the near future. Here it should keep in mind the contamination of the dykes with the Paleocene granitoid rocks, as well as partially post-magmatic alterations detected above. Based on indirect data we can restrict the geological age of the studied dykes taking into account all available information. All dykes belong to typical post-plutonic fractured intrusions crossing Paleocene granitoids after their complete solidification. In addition to granitoid plutons, the dykes intrude all latest manifestations of granitoid magmatism namely aplite and quartz veins, zones of near-fracture metasomatites. So, it was a significant time gap between the formation of granitoid plutons and dykes. Taking into account the Paleocene isotopic age of the host granitoids we have the lowest age limit of dyke magmatism which should have occurred much later than 54 Ma.

Additional information is provided by the petrographic features of the studied dyke rocks. According to their texture, they all belong to subvolcanic intrusions. It is confirmed by relict hypocrystalline textures with varying amounts of replacement products of volcanic glass. Such textures could be formed only by rapid cooling of the dykes. This is additionally confirmed by chilled endocontact zones in the all dyke bodies and by the presence of unmelted xenoliths of the host granitoids in them. During the formation of the dykes the host rocks were not only cooled but also exhumed as a result of tectonic uplift and erosion. Amygdaloidal textures indicate the presence of gas bubbles in the magma and, accordingly, low pressure and degassing processes during its solidification. Magma degassing can occur either at the surface or at shallow depths. In the latter case magma loses dissolved fluids due to pressure reduction. It can be assumed that some part of the studied subvolcanic dykes not only intruded to shallow depths, but also connected with the earth's surface and were conduits for fissure volcanic eruptions.

When could the tectonic exhumation of the host granitoides take place? The age of exhumation could be evaluated by low-temperature thermochronometric studies of granitoids of the Antarctic Peninsula and the adjacent islands (Guenthner et al., 2010). The dating of apatites from the Late Cretaceous granitoids of the Petermann Island showing the closure of U-Th/He isotopic system occurred in the Miocene of 11.1±0.9 Ma at temperatures of 50–70 °C. This data could be interpreted as the age of erosion exposure of the granitoid plutons in the Wilhelm Archipelago. Thus, the studied sublcanic dykes should have been intruded later, at the end of Neogene or even in Quaternary. Their upper age is limited by overlying Quaternary glacial deposits.

The chemical composition of the least altered Late Cenozoic dykes varies from basic to intermediate and even acidic rocks of normal alkalinity probably connected with variations in the chemistry of the parent magma. However, the discreteness of the distribution on the TAS diagram does not allow revealing the evolutionary geochemical trends in the row of basalt – basaltic andesite – andesite – dacite. The reasons could be either a statistically incomplete sampling of the entire dyke set, or natural differences between their parent magmas that were not connected by a common process of evolution. The latter is supported by geochemical differences between different groups of dyke rocks and their belonging to fundamentally different petrochemical series (Fig. 6–7). In particular, on the SiO_2-K_2O diagram, all weakly altered dykes are defined as calc-alkaline ones. At the same time, on the SiO_2-FeO*/MgO diagram, the most primitive basalt dykes of the Galindez Island tend towards the classification field of the tholeiitic series.

The identification of the geotectonic regime during dyke formation based on the geochemical characteristics is also ambiguous, see Fig. 8–9. For example, on the Al_2O_3-MgO-FeO diagram, the andesite dykes of the Barchans Islands are expected to be in the classification field of orogenic volcanites. At the same time, most of the basaltic dykes of the Barchans, as well as two basalt dykes from Galindez Island, fell into the field of oceanic volcanites. This is contrary to their geological position because these dykes intrude granitoid plutons of peripheral-continental orogenic belt. However, on the Ti-Y-Zr classification diagram, the Galindez Island dykes are drawn towards the field of intraplate basalts, while all others have the characteristics of island-arc volcanites.

Conclusions

1. The youngest manifestations of magmatism in the area of the Ukrainian research station are small subvolcanic dykes that intrude Paleocene granitoids on the Barchans, Forge, Bus, and Dannebrog Islands. They all belong to typical post-plutonic fractured intrusions cutting through the host granitoids after their complete solidification and cooling.
2. At the time of dyking the host granitoids were not only cooled, but also exhumed as a result of the tectonic uplift and erosion. The granitoids were exhumed in the Miocene, so the dykes are of Late Neogene or Quaternary age.
3. The dykes were intruded at shallow depths. At least some of them during the formation were connected to the earth's surface and were conduits for fissured volcanic eruptions.
4. The genetic relationships of most widespread basaltic dykes with subordinate andesite and dacite ones are not obvious. They probably have different sources of magma generation and are associated with different geotectonic processes. Andesite and dacite dykes represent the final manifestation of subduction calc-alkaline magmatism. The connection between subduction processes and Late Cenozoic basaltic dykes has not been proven. The clarification of the geotectonic regime of basaltic dyking requires additional research.
5. Further research should be focused on determining the isotopic age of studied Late Cenozoic dykes of the Wilhelm Archipelago, as well as on clarifying their geochemical features.

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Пізньокайнозойський магматизм на архіпелазі Вільгельма, Берег Греяма Антарктичного півострова

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На архіпелазі Вільгельма поблизу Української антарктичної станції «Академік Вернадський» виявлено прояви новітнього магматизму. Це невеликі субвулканічні дайки, які інтрудують палеоценові гранітоїди на островах Барчанс, Фордж, Бус та Данеброг. Автори дослідили умови залягання, петрографію та геохімію дайкових порід з метою з'ясування особливостей їх формування. Виявлено, що досліджувані дайки є типовими постплутонічними тріщинними інтрузіями, що вкорінювалися у вмісні гранітоїди після їх повної консолідації та застигання. На момент дайкоутворення вмісні гранітоїди були не лише охолоджені, а й ексгумовані в результаті процесів тектонічного здіймання та ерозії. Дайки ж, вочевидь, мають пізньонеогеновий або й четвертиний вік. Їх вкорінення відбувалося на незначних глибинах. Щонайменше частина дайок на момент їхнього формування сполучалася з земною поверхнею, тобто являла собою підводячі канали для тріщинних вулканічних вивержень. Геохімічні особливості найбільш розповсюджених базальтових дайок ставлять під сумнів їх генетичний зв'язок з кількісно підпорядкованими дайками андезитового та дацитового складу. Імовірно, вони мають різні джерела магмагенерації та пов'язані з різними геотектонічними процесами. Андезитові та дацитові дайки можуть являти собою заключний спалах субдукційного вапняно-лужного магматизму. Натомість, зв'язок між субдукційними процесами та пізньокайнозойським базальтоїдним дайкоувторенням не є очевидним і потребує додаткових досліджень.

Ключові слова: *Західна Антарктика; геологія; магматичні породи; мафічні дайки.*