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New data on the the field relationships of the Moores Peak breccias, Hurd Peninsula, Livingston Island, South Shetland Islands

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Абстракт. Брекчите Мурес Пик са хаотична седиментна последователност, представена от масивни, дебелопластови брекчи и лещи от конгломерати и брекчоконгломерати с ограничено разпространение в източните части на полуостров Хърд. Неясната им стратиграфска позиция се дължи на липсата на детайлни полеви данни в районите на Серо Мирадор и Мурес Пик досега. В това изследване са събрани резултатите от геоложкото картиране в мащаб 1:2000 върху разкритията на свитата Майерс Блъф, брекчите Мурес Пик и вулканските скали от групата на Антарктическия полуостров в източната част на полуостров Хърд. Приведени са доказателства, че брекчите Мурес Пик са неделима част от свитата Майерс Блъф и нейна най-горна литостратиграфска единица с ранг на член. Преобладаващият транспорт при отлагането на брекчите е осъществен чрез дебритни потоци и подводни свличания във ветрило, разположено под издигната окрайнина на екстензионен тип басейн.

Key words: canal breccias, debris flows, slumping

Introduction

The Moores Peak breccias crop out between Moores Peak and Napier Peak, eastern Hurd Peninsula (Fig.1). The deposit consists of lithologically distinctive sequence of massive sedimentary breccias. Pallas et al. (1992) interpreted this coarse sediments as uppermost part (Unit 3) of the deformed turbiditic Miers Bluff Formation (MBF). MBF was proposed to be the oldest formation in Hurd Peninsula with possible age of deposition in the Triassic-Early Jurassic interval based on Rb-Sr dated by Willan et al. (1994) and Trouw et al. (1997). The first finding of the ammonite genus *Blanfordiceras* sp. (aff. *wallichi*) favours new Late Tithonian age for the part of the Formation (Pimpirev et al., 2002). Smellie et al. (1995) formally divided the MBF into Johnsons Dock and Napier Peak Members and suggested that the Moores Peak breccias could be part of the MBF, younger separate unit or a basal unit of the Cretaceous volcanic Mount Bowles Formation. This ambiguous stratigraphic position comes from the lack of detailed field data for the exposures at Cerro Mirador and Moores Peak in eastern Hurd Peninsula.

New structural, stratigraphic and petrographic information appeared in the Willan's (1996) and Pimpirev et al. (2000) studies recently. These two papers have proposed different interpretations on the origin and affinities of the Moores Peak breccias. Willan (1996) defined the breccias as a separate lithostratigraphic unit (Moores Peak Formation) forming part of the mid- to late Cretaceous Antarctic Peninsula Volcanic Group (APVG; cf. Thomson & Pankhurst 1983). He suggested that the Moores Peak Formation was a Cretaceous debris-avalanche deposit, which may have been formed as a result of volcanic edifice collapse.

The field observations of Pimpirev et al. (2000) indicated that the Moores Peak breccias are a continuous and inseparable part of the non-volcanic sedimentary sequence in Hurd Peninsula.

This paper summarizes the results of the detailed geological mapping in 1:2000 scale on the exposures of MBF, Moores Peak breccias and part of APVG in the Moores Peak and Cerro Mirador areas. The new field data obtained give evidences that the sedimentary breccias in eastern Hurd Peninsula are the uppermost lithostratigraphical division of the MBF and cannot be a separate unit of the Cretaceous APVG.

The Moores Peak breccias and its relationships to MBF and APVG

Three sedimentological and three geological sections of the Moores Peak breccias have been studied

(Pimpirev et al., 2000). Detailed mapping in the area of Moores Peak and Cerro Mirador has been carried out as well. Correct measurements of the breccias bedding surfaces are difficult to present, because of amalgamation and rotation of the large mudstone/sandstone interbedded clasts in the matrix. Most of the MBF beds are overturned and dip to the NW, but some of them are steep to SE and in normal position (Fig. 1). The APVG rocks are steep to sub-vertical. They dip to W-WNW (Fig. 1), in agreement with Willan's (1996) data.

Contact relationships of the Moores Peak breccias with the MBF are well exposed at Cerro Mirador. The MBF shows distinctive features characteristic for the Napier Peak Member there (Pimpirev et al., 2000). The boundary trending NE-SW passes 10 m W of the Cerro Mirador summit. The best places of visible contact are situated at 50, 90 and 130 m respectively in NE direction from the summit (Fig. 1). The underlaying sediments

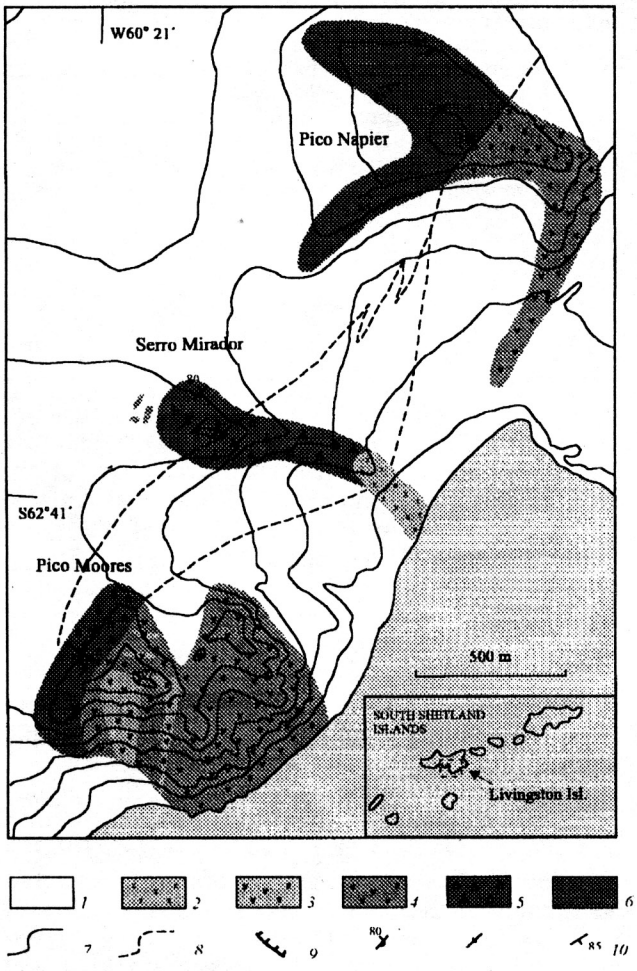

Fig. 1. Schematic geological map of the region of Pico Moores, Serro Mirador and Pico Napier (Hurd Peninsula, Livingston Isl., South Shetland Islands, Antarctica)
1 – ice; *2* – Friesland tonalite pluton; (*3–4*) Antarctic Peninsula Volcanic Group: *3* – subvolcanic andesite bodies and dykes, *4* – volcanic rocks; (*5–6*) Miers Bluff Formation: *5* – Moores Peak breccias; *6* – sandstones, siltstones, mudstones; *7* – geological boundary; *8* – supposed geological boundary; *9* – fault; *10* – bedding (overturned, vertical, normal)

of the Napier Peak Member are presented by thick massive sandstone, siltstone and mudstone with lenses and irregular layers of intraformational pebbly conglomerates and breccia-conglomerates. They are overlain conformably by thick massive cobble to boulder sedimentary breccias belonging to the Moores Peak breccias (Pimpirev et al., 2000, Fig.2, II—II). Their lower stratigraphic boundary is transitional and channelized.

The lower contact with MBF at Moores Peak is not exposed due to the ice cover, but the magnetometric observations (Dimov et al., 1997) show that the underlaying rocks are sedimentary (MBF) but not volcanic (APVG) as Willan (1996) supposed.

Willan (1996) suggested that the Moores Peak breccia was entirely assigned to the Cretaceous APVG sequence. According to him, the two large exposures of thin-bedded MBF turbidites on the northwest side of Moores Peak are megaclasts within the Moores Peak breccias. These conclusions, however, do not correspond to our field data. The both outcrops show similar orientation of bedding with the regional MBF strike in the study area and are connected continuously (Fig. 1). Some changes of the orientation in southern exposure are due to deviation of bedding plains along several strike-slip faults (Fig. 1).

The upper stratigraphic boundary of the Moores Peak breccias is exposed at 150 m WNW and 140 m NNW from the Moores Peak summit (Fig. 1). In the WNW outcrop, the Moores Peak breccias include big lenses of mudstone and sandstone (MBF) below the contact with APVG. At 140m NNW away from the summit, the massive sedimentary breccias are overlain directly by volcanic rocks. The boundary is abrupt and well divides the sedimentary (Moores Peak) breccias from volcanic (APVG) breccias. The latter consists of clasts of MBF sandstone, siltstone and mudstone only close to the contact. The content of MBF fragments decreases rapidly eastward and the abundant volcanic clasts prevail.

The upper boundary of the Moores Peak breccias at Cerro Mirador is obscure because of the presence of cross-cutting tonalite intrusion (Fig. 1).

The characteristics of the boundaries and the stratigraphic position of the Moores Peak breccias confirm that they are a conformable part of the MBF and are its uppermost lithostratigraphic division. The Moores Peak breccias are a distinctive sedimentary sequence and in spite of their restricted distribution (confined to eastern Hurd Peninsula) are the upper Member of the MBF.

Lithological description and interpretation

The Moores Peak breccias are coarse, chaotic sedimentary sequence characterized by thick-bedded breccias and irregular layers and lenses of conglomerate and breccia-conglomerate. The bed thickness is difficult to be measured because of amalgamation. The clasts are of angular, sub-angular and sub-rounded shape and pebble, cobble and boulder

in size. They are included in abundant silty-muddy or silty-sandy matrix, but clast-supported breccias could also be observed. The fine-grained matrix consists of disaggregated grains of sedimentary and volcanic origin with epidote and clinozoizite (Willan, 1996). The clasts are represented predominantly by MBF lithologies: mudstone, siltstone, sandstone and interbedded mudstone-sandstone lenses. The latter occur at Moores Peak and occasionally at Cerro Mirador as blocks up to 2.5 m thick and 10 m long. Rarely quartz and rounded granitoid pebbles, as well as volcanic pebbles and fine cobbles are also present. The extra-basin rock fragments and clasts both in the MBF sandstones and the Moores Peak breccias are most likely derived from deeply eroded magmatic arc. It consists of volcanic, igneous and meta-sedimentary rocks (Smellie et al., 1991; Arche et al., 1992).

In the Moores Peak breccias abundant silification, chloritization and epidotization are observed. This hydrothermal alteration is not related only to the breccias. It is typical for the MBF rocks outcropping between Burdick Peak and Moores Peak in close proximity to APVG (Smellie et al., 1995; Willan 1996).

The Napier Peak Member which underlays the Moores Peak breccias at Cerro Mirador consists of lenses and irregular beds up to 2 m thick. They are built of medium to coarse unsorted pebble conglomerate and breccia-conglomerate increasing in thickness and number towards the upper part of the sedimentary succession (Smellie et al., 1995; Pimpirev et al., 2000, Fig. 2, I—I). Slump blocks of sandstone are also presented. This progradation of the described sequence indicates that the deposition of the Moores Peak breccias have been determined by similar preceding sedimentary processes as turbidity currents, debris flows and slumping. The difference is in the intensity and domination of slumping and debris flows in the uppermost part of the succession.

Conclusions

— The Moores Peak breccias overlay conformably the Napier Peak Member. The lower stratigraphic boundary is transitional and channelized.

— The upper stratigraphic boundary of the Moores Peak breccias is abrupt and well divides the sedimentary (Moores Peak) from volcanic (APVG) breccias.

— The detailed field data confirm that the Moores Peak breccias are a conformable part of the MBF and are its uppermost lithostratigraphic division with Member status.

— The dominant transport for the deposition of the Moores Peak breccias has been realized by debris flows, rock falls and slumping in a fan setting along the partly uplifted faulted margin of an extension-generated basin.

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References

Andreis, R. R., A. Ribeiro, R. A. J. Trouw. 1997. Remarks on facies, paleocurrents and petrofacies of Triassic submarine fans from the Antarctic Peninsula, South Shetland Islands and South Orkney Islands. — In: Lucchi, R. (ed.) *The Antarctic region. Geological evolution and processes*, 401—407.

Arche, A., J. Lopez-Martnez, E. Martinez de Pishon. 1992. Sedimentology of the Miers Bluff Formation, Livingston Island, South Shetland Islands. — In: Yoshida, Y. et al. (eds.) *Recent progress in Antarctic Earth Science*, Terra Scientific Publishing Company, Tokyo, 357—362.

Dimov, D., V. Stanchev, A. Petrova. 1997. Magnetic anomaly map of part of Livingston Island. — *C. R. Acad. Sci. Bulg., 50*, 7.

Pallas, R., J. A. Munoz, F. Sabat. 1992. Estratigrafia de la Formacion Miers Bluff, Isla Livingston, Islas Shetland del Sur. — In: Lopez-Martines, J. (ed.). *Geologia de la Antertida Occidental: III Congreso Geologico de Espana y VIII Congreso Latinoamericano de Geologia, Salamanca.* 105—115.

Pimpirev, C., D. Dimov, H. Miller. 2000. Field studies of sedimentary sequences in eastern Hurd Peninsula, Central Livingston Island, South Shetland Islands. — *Polarforshung, 66*, 3, 1—5.

Pimpirev, C., Ivanov, M., Dimov, D. and Nikolov, T. 2002. First find of the upper Tithonian ammonite genus *Blanfordiceras* from the Miers Bluff Formation, Livingston Island, South Shetland Islands. — *N. Jb. Geol. Paont. Mh., 6*, Stuttgart, 377—384.

Smellie, J. L. 1991. Stratigraphy, provenance and tectonic setting of (?) Late Paleozoic- Triassic sedimentary sequence in northern Graham Land and South Scotia Ridge. — In: Thomson, M. R. A. et al. (ed.). *Geological evolution of Antarctica.* Cambridge University Press, 411—417.

Smellie, J. L., M. Liesa, J. A. Munoz, F. Sabat, R. Pallas, R. Willan. 1995. Lithostratigraphy of volcanic and sedimentary sequences in central Livingston Island, South Shetland Islands. — *Antarctic Science, 7*, 1, 99—113.

Thomson, M. R. A., R. J. Pankhurst. 1983. Age of post-Gondwanian calc-alcaline volcanism in the Antarctic Peninsula region. — In: Oliver, R. L. et al. (eds.). *Antarctic Earth Sciences*, Australian Academy of Sciences and Cambridge, Cambridge University Press, 328—333.

Trouw, R. A. J., R. G. Pankhurst, A. Ribeiro. 1997. On the relation between the Scotia metamorhic complex and the Trinity Peninsula Group, Antarctic Peninsula. — In: Lucchi, R.(ed.). *Antarctic region: Geological evolution and processes*, 383—389.

Willan, R. C. R. 1996. The Moores Peak Formation, a Cretaceous debris avalanche deposits in the Antarctic Peninsula Volcanic Group, Livingston Island, South Shetland Islands. — *Journal of South American Earth Sciences, 9*, 3—4, 251—264.

Willan, R. C. R., R. J. Pankhurst, F. Herve. 1994. A probable Early Triassic age for the Miers Bluff Formation, Livingston Island, South Shetland Islands. — *Antarctic Science, 6*, 401—408.

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