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Texture and formation process of jasper, ”Nishiki-ishi” from Tsugaru region, Japan

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Jasper with bright red, yellow and green colors occurs from Tsugaru region, Aomori prefecture, Japan, and is called as ”Nishiki-ishi” from its coloring. The jasper is used for ornaments at the region. The colors originate from iron-containing minerals within the jasper. Most raw stones of Nishiki-ishi are usually collected from shingle at beach, and few outcrop of the jasper is found out. Therefore, the occurrence of Nishiki-ishi has not been reported in detail. To elucidate the formation process of Nishiki-ishi, we observed textures of rocks and minerals, and analyzed the chemical compositions of minerals.

Used samples were collected from two localities: Aoiwa, Nakadomari-machi, Kita-tsugaru, Aomori prefecture, and Tappizaki, Sotogahama, Higashi-tsugaru, Aomori prefecture, Japan. Both localities are located in the green-tuff regions of Miocene, and are underline by pyroxene andesite rocks (Tappi andesite) with volcanic breccia. Silica veins of quartz, chalcedony and opal are locally developed within the rock. Nishiki-ishi mainly consists of quartz and iron containing minerals, and other minor minerals are barite, apatite and ankerite.

The textures of rocks and minerals were observed using an optical microscope and a scanning electron microscope (JEOL, JSM-7001F), and chemical analyses were carried out using an energy dispersive X-ray analyzer (Oxford, INCA system).

Quartz crystals composing Nishiki-ishi exhibit fibrous spherules with 0.1 mm in diameter or aggregations of micro-crystals with 0.05 mm in width. Comparing with chalcedony and agate, Nishiki-ishi has coarser fibers in the quartz spherules and few zonal-band texture. Origin of its colors is caused by iron-containing minerals; hematite (red), celadonite (green), goethite (yellow), siderite (yellow), pyrite (brown). These iron-containing minerals, which exhibit needle-like or granular forms, are included as fine grains in quartz spherules and fill in space among the quartz spherules.

The macroscopic structure of Nishiki-ishi is a breccia-like or clastic. The breccia fragments consist of aggregates of micro-quartz and optically length-slow types spherules. In contrast, the space among these breccia fragments is filled by clearly euhedral quartz crystals and chalcedony with optically length-fast. These are considerable differences of quartz textures between breccia and the space among of breccia fragments. The original rock of Nishiki-ishi was formed by silicification of volcanic rocks during volcanic activity. After the silicified rocks brecciated, quartz and chalcedony precipitates in the breccia.

Keywords: jasper, Nishiki-ishi, chalcedony, texture