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Effect of pore size distribution on the application of water repellent for preventing deterioration of stone materials.

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Treatments intending to prevent stone damage sometimes accelerate deterioration unexpectedly. It would be meaningless if the use of protective agents in a more severe deterioration than originally intended. A combination of the properties between agents and stones determines the ability of protective agents to penetrate the stone. In particular, it is expected to depend on the pore diameter distribution of the stone. The present study focuses on freeze-thaw and salt weathering tests were carried out by using several types of tuffs to verify this. The stone materials used were Oya tuff, Nikka tuff, Tatsuyama tuff, Ashino tuff, and Towada tuff, which have different pore size distributions, different strengths, and different durability to salt weathering. In rocks with a high proportion of micro-pores and low resistance to salt weathering, the use of protective agents (water repellents) can delay the onset of surface deterioration. On the other hand, rocks with a high proportion of large pores (>$10^{0.5}$ μm) and not less resistant to salt weathering were found to be more likely to deteriorate more severely with an earlier onset of surface deterioration than untreated stones. It is considered to be because the salts crystallize at greater depths when protective agents are applied, whereas they crystallize only at the surface in the case of untreated rocks, and the crystalline pressure causes fracture from the deeper layers. Therefore, when using protective agents, it is necessary to understand the combination of rock properties such as rock structure, pore size, and strength of the rock sample with crystal pressure.