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Seasonal and spatial variations of salt damage to brick kiln walls

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To clarify the mechanism of salt damage to a stone monument, monthly observations were made over one year at a two-storey brick kiln in central Japan. The building, named Shimoren kiln, was originally built in 1889 for manufacturing bricks, but is now no longer used and is preserved as a national important cultural property. The salt efflorescence is generally severer, and the more salt efflorescence is observed, the more bricks are damaged. Salts were identified using XRD and the weathering products fallen from the brick walls were collected and weighed. The moisture content of the brick was measured at its surface using a portable infrared optical moisture meter. Gypsum (CaSO4.2H2O) was found at the bottom of the first floor wall in the warm and humid season. Thenardite (Na2SO4) is dominant on the first floor wall; it is abundant in the cold and dry season but sparse in the warm and humid season. Magnesium sulphate is dominant on the second floor wall; epsomite (MgSO4.7H2O) was obserbed in the dry-to-wet season and hexahydrite (MgSO4.6H2O) in the wet-to-dry season. The amount of brick decay materials due to salt weathering is much greater from the second floor wall than from the first floor wall and is greater from spring to the end of summer. Seasonal and spatial variations in types and abundance of salts result from their own efflorescence-deliquescence characteristics caused by the temperature dependence of the solubilities and equilibrium relative humidities. This also affects seasonal and spatial variations of the rate of brick decay of the kiln.