

# ON THE MECHANISM OF THE NATURALLY FORMED ICE

## **SPIKES** Hi-Ryong Byun

*Dept. of Environmental Atmospheric Sciences, Pukyong National University  
Daeyon, Namku  
Busan, Rep. of Korea, hrbyun@pknu.ac.kr*

## Chang-Kyun Park

*Dept. of Environmental Atmospheric Sciences, Pukyong National University  
Daeyon, Namku  
Busan, Rep. of Korea, qkrxp2@naver.com*

### **Abstract**

'Ice spike' denotes the ice bar risen upward from the ice surface in nature. In early 19 century, Buddhist monks in valley of Mt. Mai in Jinan Jeonbuk at Rep. of Korea found a mysterious phenomenon and recorded it first. Every early night they put many manmade bowls that are 15cm diameter and 10 cm height, at the yard of the temple with enough water in it. Next morning they found an icicle rose upward from the ice surface of the bowl. Also they say that the shape of Buddha is seen in the ice bar. These phenomena occur 10 ~ 20 times a year and have been known as a mystery for a long time. This study has carried out 7 days and nights' consecutive meteorological observations, succeeded to make a motion picture that shows upward growing icicle, and afterwards, succeeded to make ice spike artificially in laboratory using refrigerator.

In animated photographs it was caught that not the ice but the water with air parcel rose upward in the bowl through the "breathing-hole" that is unfrozen part of the ice surface. At the round skin edge of the rising water, the ice wall was formed by the evaporative cooling and the conduction from the cold wind nearby. This wall made again the higher path of rising water in it. The water passing inside this wall made the wall higher and higher and finally become the ice bar about 10 ~15 cm height with many bubbles in it that was called the Buddha

shape. It is also deduced that the ice spike grows by the synchronized cooling of the bowl not only on upper part but also on lower and side parts together.

Also, it is verified that the ice spike is not a mystery but a naturally grown ice bar caused by the volume expansion concentrated to a point called "breathing-hole" when the status change from water to ice occurs, and by the buoyancy force resulting from the rising air parcel that expelled from water when it freezes. Also, the peculiar meteorological conditions related to the formation of ice spike at the valley of the Mt. Mai are summarized. Firstly, the most favorable condition for the ice spike is the persistent air temperature near 0°C for a long time. Secondly, the huge tafoni rocks of the Mt. Mai may make this favorable temperature condition frequently. When the tafoni rocks are wet or covered with snow, evaporation and/or sublimation processes make the air colder to near 0°C and make it sink into the valley. Also the latent heat released by the deposition process of water in the rock may make the air near 0°C. Thirdly, the lower topography of the valley permits only the slow intrusion of cooled air. Fourthly, the water in the valley contains much air parcels obtained during the flow down through the cold tafoni rock.

### **Keywords**

Ice spike, upward icicle, breathing hole, tafoni rock