Air entrapment effect in the runoff process

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To study air entrapment effect on rainfall-runoff process, air flow and barometric pressure were measured at wells 25 m, 60 m, and 120 m deep in Mamushi-dani and 11 m deep in Kumanodaira, where the lithology and weathering ratio of bedrock differ. During passing of low pressures, marked air flow from borehole has been observed, and stopped when the borehole air pressure become same as the atmospheric pressure. Five to 17 air flow events were observed at the wells in weathered andesite in Mamushi-dani. However, no air flow events were observed at tuff breccia and a dry porous rock area in Kumanodaira. Therefore, the air flow is considered to depend on the lithology of the bedrock.

Different type of the airflow occurred in Mamushi-dani, 25 m well, without changing the marked atmospheric pressure. During the storm event 130 mm for 28 hours, air flow of 6.5 L/min was measured at 25 m well in Mamushi-dani. The saturation of surface layer and the instantaneous increase of spring discharge were also measured at the same time. Consequently, the compressed air mass seemed to have pushed out the spring water. Furthermore, relationships between air flow and rainfall intensity suggested that surface pounding had been caused by the antecedent rainfall. Air flow measured in depth 60 m and 120 m well at Mamushi-dani fluctuated with change of barometric pressure, not by the strong short term rainfall. Bedrock in Mamushi-dani was formed by differing porosity. As comparison between the shallow layer and the deep layer at the bedrock, shallow layer was good permeability to air because of fractured rock, however deep layer was impeding layer of both water and air, inferred from the boring cores. Therefore air flow at the field shows air entrapment effect at the shallow layer because pounding had been caused by the antecedent rainfall, and barometric effect at the deep layer.