Geology and Hydrogeology of the Island of Pohnpei, Federated States of Micronesia

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ABSTRACT

The island of Pohnpei is the eroded remnant of a large shield volcano that was built up from the surrounding sea floor by the repeated eruption of mildly alkalic lava. The main island is composed entirely of volcanic material erupted episodically over the last 9 million years. The volcanic construction of Pohnpei can be divided into three stages of activity. The first was a shield-building phase dominated by the frequent eruption of alkali olivine basalt, which was followed after an eruptive hiatus of roughly 1.5 million years by sporadic volcanic activity dominated by basanitic and hawaiitic composition lavas (Awak volcanic stage). Shortly after the end of the shield-building stage, a large-scale landslide event is postulated to have removed much of the northwestern portion of the original shield volcano. The final stage of volcanic activity (Kupwuriso volcanic stage) produced voluminous flows of undersaturated lavas, which blanketed much of the southern half of the island. The thick, massive, low-permeability post-shield-building lavas of the Awak and Kupwuriso volcanic stages dominate the present-day geomorphology and hydrogeology of the island. Due to regional subsidence and sea-level rise (roughly 5.5 meters over the last 6,000 years), Pohnpei lacks extensive coastal plains of sedimentary material around its perimeter. Instead, volcanic rock and fringing mangrove swamps occur along the coastline around much of the island.

Rainfall on the island is abundant year-round and ranges from 400 cm/year along the coastline to an estimated high of 900 cm/year in the island’s interior. A high runoff-rainfall ratio (0.67) is estimated for the island’s river basins. An evapotranspiration rate of 140 cm/year is estimated for the island. These values lead to an estimated islandwide groundwater recharge of 600 to 750 million liters per day.

Groundwater development on Pohnpei has been limited mainly to areas in the northern part of the island in and around the town of Kolonia and Palikir, the new Federated States Micronesia capitol site. Wells in the Kolonia area exploit local unconformities between flow units of the late-stage volcanics and the unconformity between these volcanics and the underlying shield-building lavas. Somewhat more productive wells located in the Palikir area exploit relatively unweathered shield-building lavas. Groundwater development in the northern half of the island is hindered by the low permeability of the basement rock and by the lack of an extensive, low permeability capping layer to impede the movement of basal groundwater out into the lagoon. More favorable conditions for the development of basal groundwater are thought to exist in the southern half of the island due to the presence of relatively thick deposits of low-permeability ash near the coast, although groundwater has not yet been developed there.