# Deep Root Biomass and Interfluve Aquifer: Case of a Watershed in Northeast Thailand

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In Northeastern Thailand, dipterocarp forest was cut massively in recent decades to be gradually replaced by cash crops. The aerial parts of the vegetation were sold or burned while underground parts have been degraded with time on site by microbial activity that converts the plant tissues in organic matter more or less mineralized (humus). A drilling program to implant deep piezometers (> 25 m) allowed (i) to describe and characterize the superficial formations (XRD analysis); (ii) to observe and quantify the presence of root biomass at several tens of meters in depth. Additional analyzes (stable carbon isotope, SEM) showed that the deep roots are mainly from tree species and aged less than 60 years. The good state of preservation suggests favorable conditions such as the presence of a renewed deep groundwater.

**Keywords:** *root biomass, mineralogy, groundwater, watershed, rubber tree, Northeast Thailand*

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[3] Role of soil ecology in relation to climate change and food security

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The northeast of Thailand (NT) is dominated by a landscape of low hills with elevations ranging from 170 m (lowlands) to 240 m (highlands). Dipterocarpus forest originally occupied the highlands, but was heavily destroyed during the last half of the twentieth century. Intensive deforestation has favored the development of cash crops such as cassava, sugarcane, kenaf and maize. It is widely accepted that the change in land use has led to a radical change in the hydrological balance within the NT, namely a rise in groundwater due to the increase in deep aquifer recharge, an evapotranspiration decrease of seasonal crops and an extension of the saline contamination in the bottom of slopes and in lowlands. Studies on the deep roots of tree species are relatively limited because the investigative tools access to limited information. The purpose of this study is to (i) characterize the mineralogy of the deep surface formations along an interfluve toposequence; (ii) detect traces of root biomass in the geological substrate; (iii) if possible, interpret the origin of the deep roots.
Located near the village of Ban Nong Tun and about 20 km southwest of the city of Khon Kaen, in the district of Phra Yun, the studied watershed has an area of 2 $km^2$. The soil profile includes a clay layer of varying thickness over bedrock (sandstone-siltstone) and below a sandy surface layer. The depth of the clayey layer is less than one meter at the top of the slope and increases along the slope up to a few meters. The sandy layer has iron oxide stains which reflect the mobility of iron under reducing conditions. Three boreholes (worm screw) were implemented for deep piezometry (PB1K, PB2K and PB5K). Disturbed materials were sampled every meter for a mineralogical analysis by X-ray diffractometry. On each sample the root biomass was weighed. Isotopic measurements ($^{13}C$ and $^{14}C$) and scanning electron microscopy observations were performed on some root samples.

The main results show that quartz, kaolinite and smectite are the predominant minerals in the clay fraction with some illite. Quartz is the major component of the non-clay fraction with a small amount of feldspar and traces of goethite. The distribution of root biomass as a function of depth indicates a high amount of root biomass (from 0.1 to 1.8 g $1000g^{-1}$) at a depth ranged from 20 m to 30 m. The root biomass occurs below the actual groundwater level. The deep roots are in a good state of preservation and assigned to trees. The current presence of a water table suggests that the roots of the past trees had to reach a water-saturated zone, probably deeper, to meet the water and nutrient requirements with minimal energy. In conclusion, root biomass was observed and quantified at several tens of meters in depth. The proximity of a groundwater body is a favorable environment for the development of a deep root system which is probably widespread throughout the deforested environment insofar textural discontinuities do not prevent the root progression in depth.

Keywords: *Root biomass, Mineralogy, Groundwater, Watershed, Rubber tree, Northeast Thailand*