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Spread of denudational processes in seepage channels in a postglacial area (north-western Poland)

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Erosion by emerging groundwater (i.e., seepage erosion or groundwater sapping) is the primary mechanism initiating stream channels (so-called seepage channels) and headward growth in lowland areas with a high infiltration capacity of sediment where the surface runoff is relatively rarely observed. Around groundwater outflows, as a result of the impact of denudational processes, develops an alcove, which is an amphitheatrical depression, often of steep slopes, separated from the slopes of the initial depression with clear edges. A spring-formed alcove is the upper boundary of a concentrated flow of water and sediment transport between well-marked channel margins. The influence of groundwater remains one of the least understood factors in the landform evolution in the postglacial zone of Western Pomerania (north-western Poland).

Morphometric and lithological surveying of about 80 spring-formed alcoves were studied in the southern part of the Parsęta catchment (NW Poland) made it possible to identify morphological effects of seepage erosion which are combined with surface wash and mass movement processes. The co-occurrence of various denudational processes in the headwater zones produces variations in the accumulation conditions, and as a result, a diversity of deposits. The mineral series includes erosional pavements, colluvium, and alluvial deposits. Changes in hydrodynamic conditions are favourable to organic accumulation (peats and organic-mineral muds) as well as chemical and biochemical deposition (calcareous tufa and precipitation of Fe-oxides). Seepage channels grow when they attract enough groundwater to remove clastic material from the heads. Depending on the discharge volume of the outflow from the ten observed spring-formed alcoves (1-73 L/s), products of mechanical denudation (4-54 mg/L) are transported from the slope system to the fluvial system.

The morphometry of the spring-formed alcoves as well as deposits found in them reflect stages of their development. Changes in the development of the channel heads occur as a result of variations in the groundwater table that are due to changes in climatic conditions or land use. The determination of the place and formation of the beginning of a river channel initiated by groundwater outflows is of key importance for the modelling of the development of a stream network.