HYPERPOLJES AND RING POLJES

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Classical poljes mainly develop in carbonate rocks, though they may include non-carbonate lithologies to some extent. These landforms can be schematically characterised by a flat bottom, peripheral centripetal slopes and one or more ponors. Border poljes develop at the outer edge of karst massifs and also include non-carbonate rocks.
Two more types of poljes can be found under specific conditions, as now described.
Hyperpoljes are well exemplified in the Khammouane Karst of Laos, with the Nam Pha Thene (or Phon Tiou) depression. They are characterised by:

- a closed depression with an endoreic drainage pattern (in Nam Pha Thène (=NPT), there is nevertheless two very minor, very narrow, nearby breaches along a single exoreic river system; these breaches likely represent former cave passages which are now collapsed and enlarged. The rest of the hyperpolje shows fully endoreic conditions. Size of NPT depression: 26.5 x 9 km).
- peripheral cliffs (NPT: 200 to 300 m, even up to 400 m high) and rare steep slopes, almost all in carbonate rock.
- a bottom made up of mainly non-carbonate lithologies (NPT: sandstone, shale, granite, tin-bearing alterites, with occasional carbonate remnants).
- a bottom largely sculptured by erosion (NPT: nearly 600 m difference of elevation), with a broadly radial drainage pattern toward sinkholes and the single exoreic river system mentioned above.
- a lack of ponors: only peripheral absorption points can exist.

Hyperpoljes are interpreted as a well advanced case of polje evolution. Due to:

- a regional uplift, which is proved with a number of data including fission tracks analysis on apatites from sandstones,
- a subordinate lowering of the polje bottom down to the underlying non-carbonate lithologies, on which flat landforms are not preserved,
- and the progressive retreat of the polje peripheral slopes or cliffs in relation with lateral enlargement by dissolution (notches), related cliff collapse and cliff destruction by successive rock falls,

the initial polje shape is altered and the closed carbonate cliffs are surrounding a hilly landscape with some remaining karst towers.

The Khammouane Karst shows a variety of intermediate landforms from classical poljes to hyperpoljes. The latter continue their evolution with a progressive breaching of the depression periphery and an evolution of the internal relief, leading to an ever higher proportion of exoreic drainage. Examples also exist in Khammouane, as the Ban Phin depression.

Ring poljes are closed depressions around a central elevation of non-carbonate rocks, which is higher than the top of surrounding carbonate. Ring poljes can be compared to circular border poljes. The non-carbonate lithologies provide significant run-off of acidic waters towards the surrounding karst. The drainage pattern is radial and fully endoreic. The Calbiga Karst in Samar, the Philippines, shows one such ring polje, to the north-east of the Langun-Gobingob Cave system. In Khammouane, intruded granites have likely played some role in the evolution of the NPT depression, in addition to the other factors already indicated.

Such specific karst features as hyperpoljes develop preferably in thick carbonate formations. In Khammouane for instance, the whole Permo-Carboniferous carbonate section is around 1100 m thick. It is a combination of limestone and dolomite in variable proportions, with rare end members and a well advanced state of diagenesis.

Probably, a long karst evolution is necessary, as is the case in Laos, where two very long episodes of uplift, erosion and karstification took place: from Permian to Liassic and from Cenozoic to Quaternary. In this way, the lateral and vertical polje development lasts a sufficient time span for the carbonate floor can be reached, though the walls still exist.

Ring poljes well develop also in thick carbonates, as in the Cenozoic carbonates of Samar, which are a few hundred metres thick. Though, the limestone in Samar is moderately diagenitised and the ring poljes can form under moderate periods of time.