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Remarks on the pothole erosion at the Tormes river (Salamanca Province, Spain)

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SUMMARY

Near the igneous rock-schist contact, in the vicinity of Santibáñez de Béjar (Salamanca), numerous potholes become visible at a complex intrusion of acid, intermediate and basic plutonic rocks. The mechanism and characteristic features of these are described.

RESUMEN

En torno al contacto rocas ígneas-esquistos, en las proximidades de Santibáñez de Béjar (Salamanca), numerosas «marmitas de gigantes» ocupan el lecho del río y terrenos circundantes, todo sobre una intrusión compleja de rocas plutónicas ácidas, intermedias y básicas. Se describe el mecanismo genético correspondiente, así como el conjunto de rasgos característicos.

In the vicinity of Gijuelo, southeastern Salamanca province, a course of the Tormes river is developed within an area built up mainly of mica schists. This segment of the river valley attains its bankful stage only during seasonal heavy rainfall. Upstream from the abovesaid segment of the river, the Tormes river valley follows the contact between the aforementioned mica schists and the granite of the Central System prolongation, while farter to the south its course lies entirely across an area of granitic rocks. The data discussed in the present paper are primarily derived from this latter part, fig. 1.

During an alluvial sediment survey, for prospecting metallic mineral deposits in this zone, an irregular pattern of places of minerals concentration on the bank and river bed (pits, rips, etc.) were found, with unexpected ores from the big granitic body (mainly of Sn and W minerals). Later, research led to the finding of gabbros, similar to those refered by García de Figuerola and Franco (1975) towards NE and by Saavedra (1978) towards NW, with very coarse-grained cordieritic granites, mineralized oriented leucogranites and normal granodiorite; the two last rocks are rich in enclaves (Saavedra, 1980). Thus, itis desirable to know this mechanical weathering for the placer valuation.

With respect to the subject of this study, of particular interest are the exposures located between Santibáñez de Béjar and Puente del Congosto, where the Tormes river valley is cut down across a fragment of mixed granite, intermediate

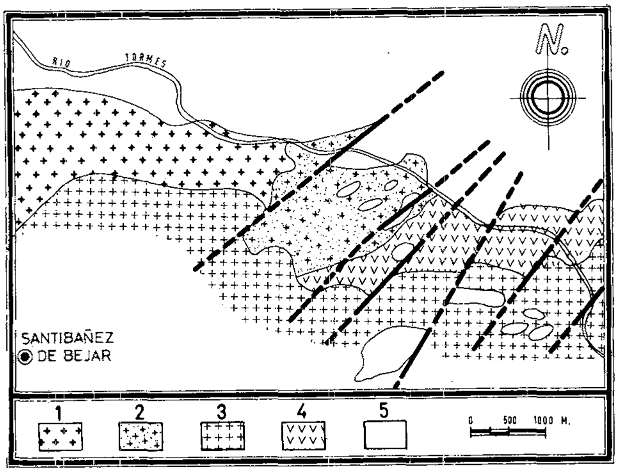

Fig. 1. Geological setting of the studied area (Saavedra, unpublished data). 1 Very coarse grained granite. 2 Oriented leucocratic granite (W, Sn). 3 Biotite granodiorite. 4 Acid, intermediate and basic plutonic rocks. 5 Metamorphic rocks (schists, quartzites, gneiss, etc.).

and basic intrusions. In this vicinity, at low water stages there occurs the emergence of river floodplains extending to the contact with metamorphic rocks and numerous classically developed potholes become well visible along the margins of the main river channel (photo 1). The potholes are increased within the granitic rocks and are present both as various incipient forms (i. e., small and relatively shallow scours with granite pebbles resting on their bottom) and as characteristic, advanced forms which are up to 2 m deep. They are always round-shaped in plan, and their diameters range from 20 cm to about 1 m. In vertical cross-sections, the potholes are cylindrical in their upper portions and become narrower, cone-shaped downwards. They are always floored with very well rounded granitic pebbles of which the larger are more or less spherical in shape, whilst the smaller ones (less than 10 cm in diameter) are usually flatter and more discoidal, photos 2 and 3. The pothole bottom is always covered with sand, the bulk of which is probably produced through the abrasion of both the pebbles and the pothole walls and floor, photo 4.

The mechanism of this pothole origin is schematically presented in fig. 2. At an earlier stage, the down-cutting of the river channel takes place, and the process results in local counter current flow, figs. 2(1) and 2(2). The action of the counter currents lead to the undercutting of the river bank, wich in turn results in the channel floor, fig. 2(3). On these latter bare-rock shelves the rock debris derived from the dumping of material from the undercut bank are accumulated. At this stage, along the river bank, progressive and descending eddy currents appear, fig. 2(4), which are responsible both for the origin of steep bank-wall segments and for the gyratory motion of the debris on the surface of the subaqueous shelf. Eddies of this type are widely known to develop along a river bank at the downstream ends of any sort of obstacles resistant to the current.

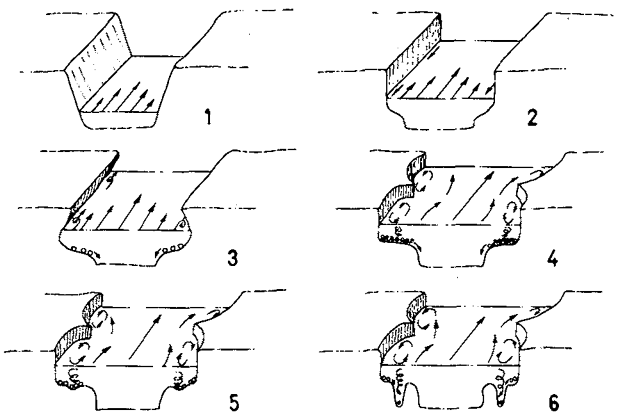

Fig. 2. Schematic sketch of the stream erosion leading to the origin of potholes (see text for explanation).

Due to the action of descending eddies, the rock debris, which is preserved and resting upon the uneven shelf floor, starts to move slightly back-and-forth and produces small abrasional scours within the underlying base rock, photo 5, fig. 2(5). As the abrasional scours gradually increase in size, additional debris gets inside, photo 6, and all the rock particles remain there in a regular motion due to the persistent gyratory movement of the water current; this is accompanied by the progressive abrasion of both the scours walls and the pebbles themselves, the process representing a sort of «abrasion mill». It is precisely at this latter stage when the formation of a real pothole starts, fig. 2(6).

Initially, the pothole is developed as a cylindrical form with a fairly constant diameter throughout. Later, however, when the pothole becomes deeper and contains more debris, the gyratory movement of the pebbles is restricated and their frictional force gradually decreases; as a consequence, little by little a «freezing» of the abrasion mill takes place. Indeed, the diameter of the pothole starts to decrease as from a particular depth and movement, photo 4. In all instances, however, the depth of a pothole appears to be proportional to its diameter.

Photo 1. General view of the potholes developed along the margin of the main river channel.

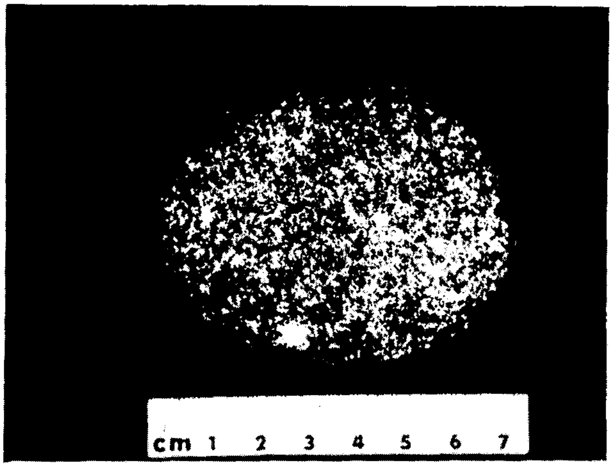

Photo 2. Circular view of granitic pebble from the pothole visible in photo 6.

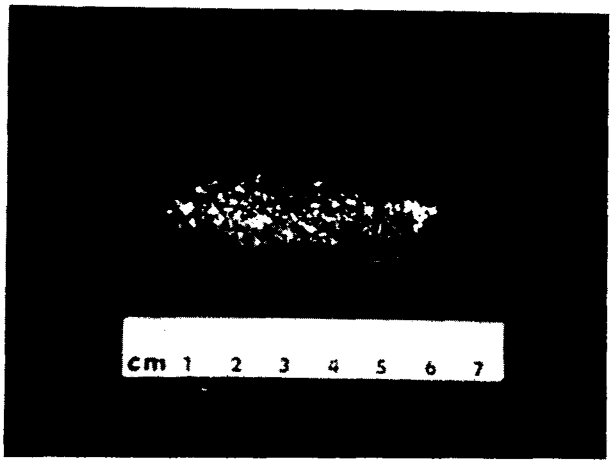

Photo 3. Id., from another position.

Photo 4. The pothole's bottom covered with sand.

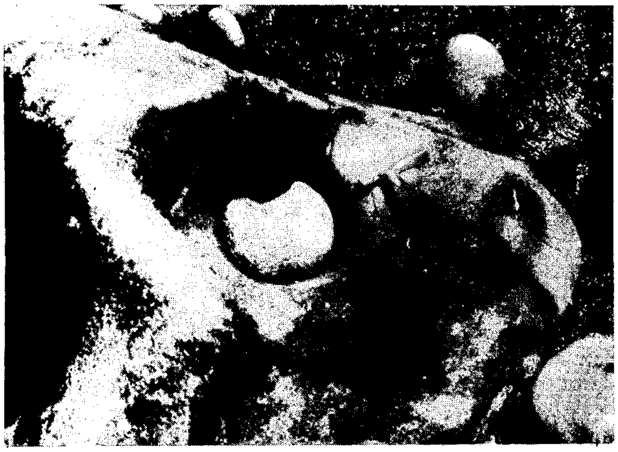

Photo 5. Spherical granite pebble on the bottom of small abrasional scour.

Photo 6. Spherical (bigger) and discoidal (smaller) granitic pebbles on the bottom of the pothole.

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