Hydraulic Controls on Flow Properties in Bedrock Channels: Evidence from Lateral Potholes

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Abstract: Lateral potholes, formed by vertical vortices attached to stream channel walls, are hydraulically-formed inertia-driven engines that simultaneously dissipate energy and erode knickpoints in bedrock streams. The concentration of lateral potholes at knickpoints, within resistant strata, and scaling of lateral pothole geometries confirm that they are not breached potholes. The development of lateral potholes is due to small, initial perturbations in local flow fields that evolve into self-perpetuating hydraulic forms. As these hydraulic forms enlarge, they may reach dimensions comparable to their host channels and dampening fluctuations in flow rates and depths by converting freestream inertia into angular momentum and friction loss. During declining flows, inertia is returned to the mainstream flow as angular momentum decreases. As such, large lateral potholes act as inertial buffers and superceded bedrock resistance as the primary control on flow properties. As such, lateral potholes offer unambiguous evidence that bedrock channel geometries can be controlled by hydraulics, at least where erosion processes are efficient.