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From antidunes to step-pools

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Step-pools are bed morphologies that are typical in high-gradient streams , recognizable by a staircase-like longitudinal profile resulting from accumulation of cobbles and boulders that are transverse to the channel and alternating with pools containing finer sediments. Within the last two decades step-pools have been the subject of increased efforts to characterize their nature; however their origin is still in debate. Researchers have very soon suspected step-pools to be the residual form of antidunes produced during flooding, but this hypothesis was continuously contested. Other theories has been proposed, considering, that step-pool profile develops a maximum flow resistance, or that pools geometry is controlled by the energy of a falling jet, or that steps form by boulders accumulation in a channel-spanning manner. All these theories gave very satisfying results when compared with experimental data, but does it mean that the antidune theory should we abandoned? We performed new flume experiments on steep slopes to investigate the antidune origin for step-pools. Our experiments showed that step-pools can have several origins, depending on the flow conditions and sediment mixture used. In some circumstances antidunes were well observed but did not produce stable step-pools morphology. In many occasions, step-pools obtained in the flume were isolated step-pools, with no real apparent periodicity. Only a few flow and sediment conditions allowed us to reproduce trains of antidunes which stabilized at the flow recession to produce stable periodical step-pools. These conditions are presented and discussed.