Luminescence dating can potentially be applied to determine the burial ages of rock surfaces. As part of testing the reliability and applicability of this technique, we sampled a series of modern riverbed cobbles along the Shiyang River, which occupies an endorheic basin in northwest China. The infrared stimulated luminescence (IRSL) signal was measured as a function of depth for cobbles of two different lithologies (sandstone and granite). The results show that (i) the bleaching rate of the signal for light-coloured granite is higher than for opaque dark-coloured sandstone, because granite is bleached to greater depths than sandstone; (ii) cobble daylight bleaching depths show a downstream increasing trend, with almost all bleaching occurring in the upstream section; and (iii) despite possible abrasion of the upper surface of granite cobbles, the bleaching depth in the upper surface is greater than in the lower surface, indicating longer exposure times for the upper faces of cobbles. This work has important implications for the age-dating of fluvial deposits and the potential application of luminescence techniques to understand transport and deposition in fluvial environments.