We present results from a series of experiments that inject dyed water (a magma analogue) into solidified layers of gelatine (a crustal analogue) to give insight into magma ascent processes in the brittle elastic crust. The experimental intrusions are pressure-driven and are injected under initially hydrostatic conditions into solidified gelatine comprising three layers of varying thickness and contrasting rigidity. We address the particular case where the middle layer is thin and the most rigid. Our experiments show the rigid layer can act as a barrier to experimental dyke propagation, even for relatively thin layers with modest rigidity contrasts. Our results indicate that the strength of the interface between intruded layers can play a key role in whether an experimental sill or lateral dyke is formed. A weak interface was intruded by an experimental sill, whereas a strong interface caused lateral experimental dyke formation underneath and perpendicular to the interface. Extrapolating to nature brings forth the question of lithological contact strengths, both in absolute terms and relative to the strength of the parent units. We carried out a series of tests on cylindrical samples of sedimentary rock using a 25 kN servo hydraulic test machine. We measured at what load a crack cut in the centre of the cylinder, running along the lithological contact between layers, propagated. We determined the fracture toughness of the interface and compared this with that of the parent units, enabling us to comment on the role interface strength has on the mechanics of magmatic intrusions.