



Supplemental Item S1 - Rugged, glaciated, massive volcanoes (A-E) make conventional bedrock sampling challenging. Photographs and cross-sections profiles in B and C show the massive scale of ice-covered Mt. Wrangell shield volcano, which has a volume of >900 km³ (Nye, 1983). The volume of Mt. Zanetti, a large cinder cone on the west flank of Mt. Wrangell volume is similar to that of Mt. St. Helens. F and G show photographs of representative proglacial rivers that allow for efficient sampling of sand and gravel eroded from the rugged glaciated volcanoes (F - East Fork Glacier/River; G - Kotsina River). H - Representative sample of felsic intrusive (light-colored clasts) and mafic to intermediate volcanic (dark colored clasts) clasts that dominate unconsolidated gravels on modern river bars.