Recent work has shown that the optically stimulated luminescence (OSL) signal can be used to determine the duration of daylight exposure for rock surfaces, complementing the surface exposure dating technique using cosmogenic nuclides. In this study we investigate the feasibility of using the newly developed OSL Surface exposure dating technique (OSL-Surf) to date flake scars at lithic quarry sites. We performed the first quantitative validation of the model describing the OSL-Surf dating technique using a controlled laboratory experiment. Our results show that longer laboratory bleaching durations yield deeper OSL-depth profiles, validating the use of OSL-Surf approach for relative dating of rock surfaces with different exposure ages. The OSL-surf model fitted to the OSL-depth profiles (excluding one outlier) yields accurate estimates of known exposure duration, thus confirming the method’s usefulness as an absolute dating tool. Consequently, we used the OSL-Surf technique to determine an exposure duration of 117 ± 37 a for a previously unknown-age flake scar that is related to human exploitation of a lithic quarry site in Tibet. The problem of finding a known-age rock surface for parameter calibration was solved by revisiting the sampling site and collecting the scar remaining after earlier sample collection, which has a precisely known exposure age (1.667 a in this study) and identical lithology and irradiation aspect as the flake scar. The calibration sample yielded a measurable OSL-depth profile that could be used to calibrate the model to estimate the exposure duration of a flake scar associated with human exploitation of the area. Finally, we observe that the μ parameter of the OSL-Surf model varies considerably between the laboratory-bleached and two naturally daylight-bleached datasets, despite having identical lithologies. We thus infer that, in addition to lithological controls, the μ parameter is primarily sensitive to the daylight irradiation geometry and only weakly dependent on spectrum of the incident light; this interpretation implies a narrow effective bleaching wavelength band in quartzite. From the practical viewpoint, our results suggest that geometrical factors deserve a careful consideration both while designing the laboratory bleaching experiments as a surrogate of natural bleaching, as well as while choosing the field calibration samples.