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Assessment of rocks vitrification and vaporization in laboratory samples

Lead Beneficiary: UNIPD

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ABBREVIATIONS AND GLOSSARY OF ACRONYMS

Acronym	Extended definition
BSE	Backscattered electron
DG	Department of Geosciences
DLT	Discrete Laser Tests
EDS	Energy Dispersive Spectroscopy
FEG	Field emission gun
IR	Infrared
LLT	Linear Laser Tests
OM	Optical microscopy
PPL	Plane polarized light
ROP	Rate of Penetration
SE	Secondary electron
SEM	Scanning Electron Microscopy
SR	Red sandstone
SY	Yellow sandstone
TCS	Thermal Conductivity Scanner
UNIPD	University of Padua
WD	Working distance
XPL	Crossed polarized light
XRD	X-Ray Diffraction
XRF	X-Ray Fluorescence
Symbol	**Definition**
P	power (kW)
ρ	density (g/cm^3)
P_ρ	power density (W/cm^3)
E	Young's Modulus (GPa)
Ab	water absorbance (%)
V_p	P-wave velocity (km/s)
V_s	S-wave velocity (km/s)
v	Poisson's ratio (-)
G	shear modulus (GPa)
λ	thermal conductivity (W/m·K)
C_p	volumetric thermal capacity (J/m^3·K)
α	thermal diffusivity (m^2/s)
S_E	specific energy (kJ/cm^3)
t_i	time of irradiation (s)
T	temperature (°C)
T_s	average temperature of spallation (°C)

PUBLISHABLE SUMMARY

This report focuses on the vitrification process of melted rock. Laser-drilling experiments were performed on blocks of four types of rocks: granite, sandstone, limestone and basalt. Occurrences of melting, quenching and formation of glass were investigated. Vitrified rock i.e., glass was characterized, including mineral and chemical composition, permeability, and integrity through analyses in laboratory. During the laser experiments glass was obtained in situ (on borehole walls) and from the accumulation of thermally spalled particles that partially melted and coalesced. Furthermore, the damage induced by thermal spallation on the borehole walls was investigated showing a significant change only at 1 mm depth into the rock. Cuttings (spalls) were also collected and examined.