UNIVERSITÀ DI PAVIA
DIPARTIMENTO DI SCIENZE DELLA TERRA E DELL'AMBIENTE
DOTTORATO DI RICERCA IN SCIENZE DELLA TERRA E DELL'AMBIENTE

FORM PER PROGETTI BANDO DOTTORATO

1. Project title

Fault zones and fracture networks: insights from Digital Outcrop Model and Artificial Intelligence

2. Proposer

Surname	Menegoni
Name	Niccolò

3. Research Unit

Surname	**Name**	**Institution**
Cusano	Claudio	UniPv - DIII
Finkbeiner	Thomas	KAUST
Richard	Pascal	PRGeology

4. Key words
(Max. 5 – at least 2)

Faults; Artificial Intelligence; Digital Outcrop Modelling; Structural Geology; Geomechanics;

5. Abstract
(Max.1.500 characters with spaces)

Faults and fractures are some of the most complex objects within geology, engineering, and physics. Despite decades of study, our understanding of fault and fracture network, especially their arrangement, intensity and connectivity, remains limited due to the intricate interplay of geological, mechanical, and environmental factors that govern their genesis and evolution. Faults and fractures play a fundamental role in a wide range of natural and engineered processes, from seismic activity to subsurface fluid flow and rock mass stability. However, traditional approaches to characterizing faults and fractures often oversimplify them, failing to depict their spatial variability. This gap in knowledge has significant consequences for fields such as geomechanics, hydrogeology, reservoir engineering, and geotechnics, where fracture arrangement, intensity and connectivity are crucial to understand how stress is distributed, how rocks fail, and how fluids flow in the subsurface.
This project aims to address these research gaps by developing and applying Digital Outcrop Modelling (DOMs) and Artificial Intelligence (AI) for the structural analysis of one of the most impressive outcrop analogues worldwide, represented by cretaceous carbonates: the Jebel Shams (Oman). Its DOM with a mm-resolution and a 3D kilometric spatial geometry and extension, allows to resolve the geometric and structural complexity of a 3D seismic scale fault zone and related fracture network.