Supplementary Material

Evidencing subtle faults in deep seismic reflection profiles: Data pre-conditioning and seismic attribute analysis of the legacy CROP-04 profile

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Contents of this file

>   Figures S1 to S4

Additional Supporting Information (Files uploaded separately)

>   Caption of the movie file S5

Introduction

This supplement includes four supporting figures and a movie cited in the main document. This material has been extracted by the seismic project realized to process and analyze the profile CROP-04 NVR. The figures and the video show unprecedent, high resolution geological and structural information, with many details, across the Irpinia area, which is among the most seismically hazardous sector of the Mediterranean region. This material is aimed to provide a comparison, from different views, of the original stack (http://www.crop.cnr.it/) vs the newly reprocessed deep seismic reflection profile CROP-04 NVR. The benefits obtained from a workflow combining data pre-conditioning techniques and co-rendered seismic attributes, allows to display a seismic fabric interpreted as normal faults sets, which were rather invisible within the original data. The achieved

definition of the location, hierarchical organization, and geometry of seismogenic faults is critical for seismotectonic research and seismic hazard studies. This approach can be extended not only to this specific study area dominated by active extensional tectonics, but also in other contexts worldwide. Such a workflow has proved to be very effective to revive legacy seismic profiles, enabling an affordable approach to a re-evaluation/re-processing/re-assessing of the vintage data.
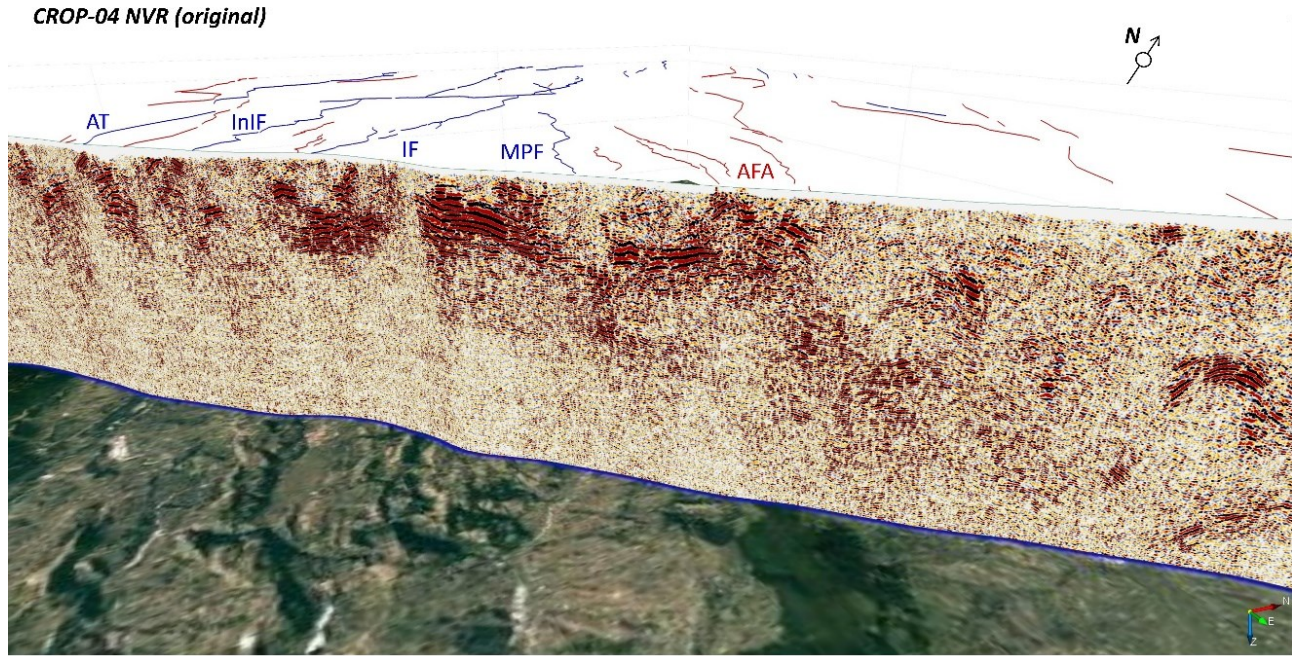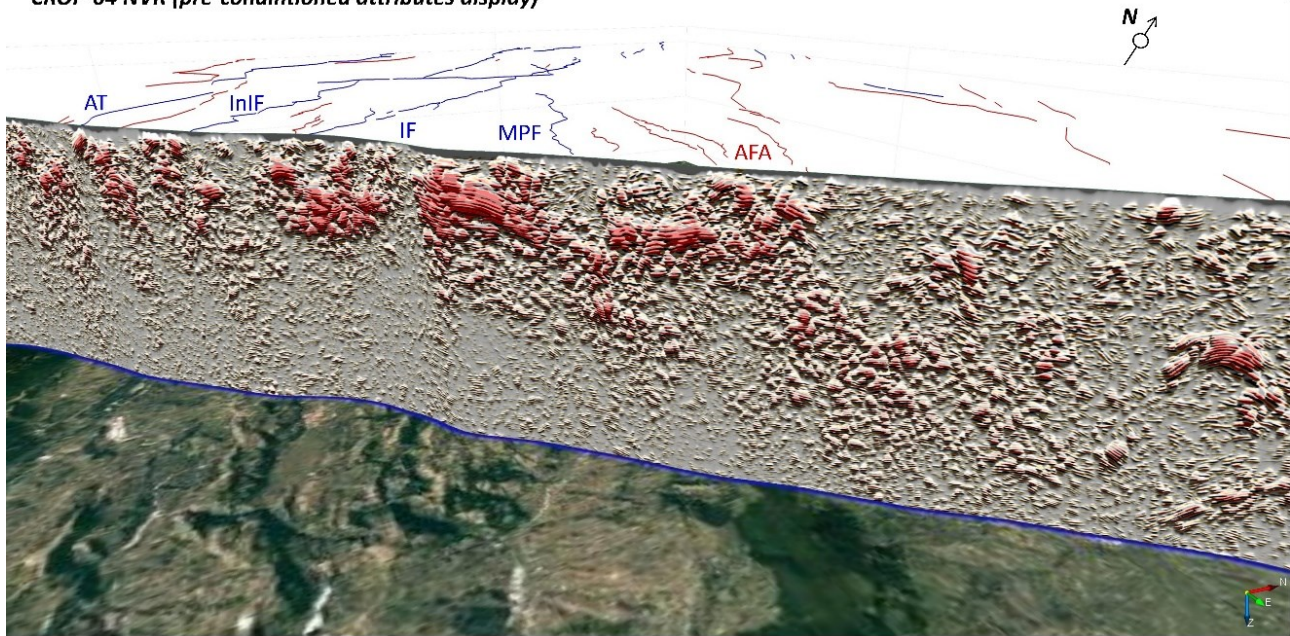

Figure S1. Pseudo-tridimensional visualization of the CROP-04 NVR profile, view from SE. Such a seismic profile, in the original version (http://www.crop.cnr.it/), shows high level of random noise masking the geophysical signature of the main tectonic structures and sutble normal faults; the fault pattern mapped at the surface is plotted above the seismic profile (blue and red lines, AT = Alburni-Tanagro; InIF = Inner Irpinia Fault; IF = Inner Irpinia; MPF = Monte Paratiello Fault; AFA = Antithetic Antithetic Fault Alignmen, see Bello et al., 2021).

CROP-04 NVR (pre-condintioned attributes display)

S2

Figure S2. Pseudo-tridimensional visualization of the CROP-04 NVR profile (view from SE), resulting from the workflow combining pre-conditioned seismic attributes. The enhanced quality of the seismic profile after the removal of random allow to visualize a seismic fabric interpretable as a dense network of normal faults, responsible for the seismicity of the area. The surface fault pattern described in S1 is matching very well with the seismic signature of the faults at depth, revealing high structural complexity and wide deformation distributed across the area.
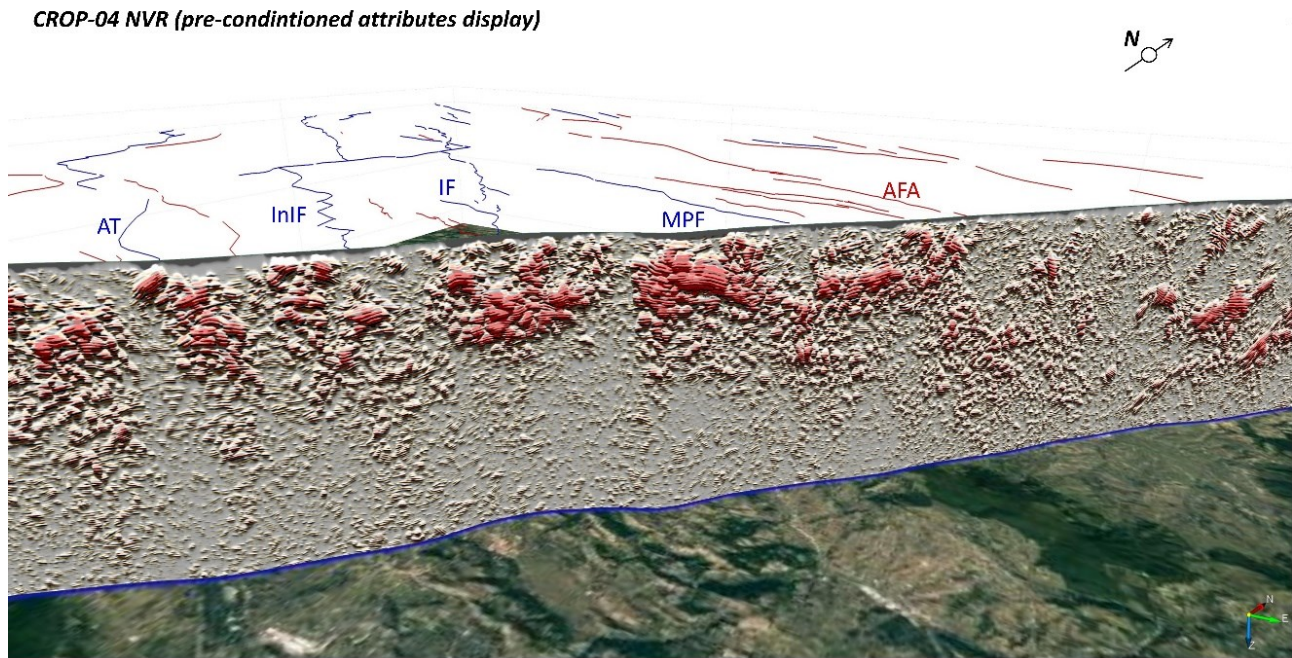

CROP-04 NVR (original)
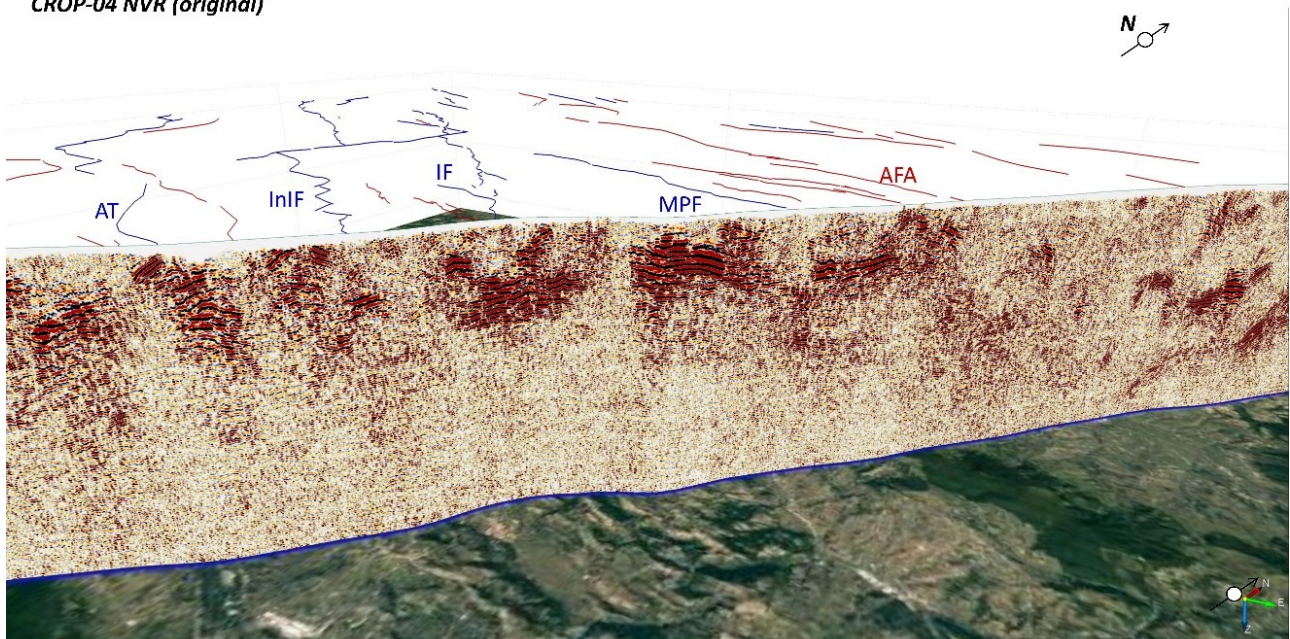
S3

Figure S3. Pseudo-tridimensional visualization of the original, noisy CROP-04 NVR profile, analogous to fig. S1; view of the Irpinian sector from the SW.

CROP-04 NVR (pre-condintioned attributes display)

N

AT   InIF   IF   MPF   AFA

S4

Figure S4. Pseudo-tridimensional visualization of the CROP-04 NVR profile (view from the SW), analogous to Fig. S2, but displayed after the computation of the pre-conditioned seismic attributes. The workflow is very effective to revive this deep seismic profile, strongly enhancing its interpretability and revealing regional and local faults, their geometry and organization, which are fundamental information for seismotectonic research and seismic hazard assessment.

Data Set S1. Image extracted by a short movie "***CROP-04 NVR: original stack vs new pre-conditioned seismic attributes version***" (Mendeley data, available at this link: doi:10.17632/w22p6fr9hn.1). This video illustrates the location of the CROP-04 NVR profile, the faults pattern mapped at the surface (from Bello et al., 2021, here reported only on the NE sector for a clear visualization), as well as an effective comparison between the original, noisy CROP-04 NVR and, our novel CROP-04 NVR version resulting from the workflow combining pre-conditioning techniques and seismic attributes extraction.