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NATIONAL GROUP FOR SOLID EARTH GEOPHYSICS

11 -14 FEBRUARY, BOLOGNA

BELMELORO CAMPUS, VIA ANDREATTA 8

TOPIC 1 - SEISMICITY, VOLCANOES, DATA AND MODELS

Session 1.1: Earthquakes, Active Faults and Seismogenic Processes: from Field Surveys to Laboratory Experiments

Convenors of the session:

Paolo Galli (DPC) - Angela Saraò (OGS) - Stefano Solarino (INGV) - Simone Bello (UniCH)

Session 1.2: The role of geofluids in earthquakes, volcanoes and geothermal fields

Convenors of the session:

Mimmo Palano (UniPa) - Francesca Forni (UniMI) - Luigi Passarelli (INGV-BO)

Session 1.3: Physical models for the Solid Earth and integration between modeling and data of different nature

Convenors of the session:

Anna Maria Marotta (UniMI) - Carla Braitenberg (UniTS) - Massimo Nespoli (UniBO) - Barbara Orecchio (UniME)

TOPIC 2 - DISASTER RISK ANALYSIS AND REDUCTION

Session 2.1: Earthquake and tsunami hazard: different return periods, different conceptual schemes and models in a continuum spectrum of time

Convenors of the session:

Daniela Di Bucci (DPC) - Dario Albarello (UniSI) - Bruno Pace (UniCH)

Session 2.2: Science and technology to support earthquake prevention and preparedness

Convenors of the session:

Mauro Dolce (UniNA) - Sara Sgobba (INGV) - Maria Polese (UniNA)

Session 2.3: Risk Communication

Convenors of the session:

Serena Tagliacozzo (IRPPS, CNR) - Valentina Rizzoli (CORIS, Sapienza University of Rome)

TOPIC 3 - APPLIED GEOPHYSICS FOR ENERGY, ENVIRONMENT AND NEW TECHNOLOGIES

Session 3.1: Energy Transition and Resources

Convenors of the session:

Vincenzo Lipari (OGS) - Paolo Mazzuchelli (ARESYS) - Erika Barison (OGS)

Session 3.2: Near Surface Geophysics

Convenors of the session:

Chiara Colombero (Polito) - Emanuele Forte (UniTS) - Michele Cercato (Uniroma)

Session 3.3: Theoretical and Methodological Development in Applied Geophysics

Convenors of the session:

Andrea Tognarelli (UniPI) - Luca Masnaghetti (SLB) - Gianluca Fiandaca (UniMI)

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Geodetic Insights into the 2024 Wushi (North-Western China) Seismic Sequence: Mw 7.0 Mainshock and Mw 5.7 Aftershock from InSAR Data

N. A. Famiglietti[1], D. Cheloni[2,*], R. Caputo[3], A. Vicari[1]

[1] Istituto Nazionale di Geofisica e Vulcanologia, Sezione Irpinia, 83035 Grottaminarda, Italy.
[2] Istituto Nazionale di Geofisica e Vulcanologia, Via di Vigna Murata 605, 00143 Roma, Italy.
[3] Department of Physics and Earth Sciences, Ferrara University, 44122 Ferrara, Italy.

The 2024 Wushi seismic sequence started on 22 January 2024 (18:09 UTC) with a MW 7.0 event, followed by dozens of aftershocks, striking the southwestern sector of the Tian Shan Mountains in Wushi County (northwestern China) (Fig. 1), characterized by high geodetic strain rates (Wang & Shen 2020; Li et al. 2021). According to the United States Geological Survey (USGS), the earthquake's hypocenter was approximately 13 km deep, located in the Southern Tian Shan Mountains, about 130 km northwest of the city of Aykol. The earthquake was felt near the epicenter and across western Xinjiang Province, parts of eastern Almaty Region in Kazakhstan, and eastern Kyrgyzstan, resulting in damage and casualties. The subsequent seismic sequence included numerous aftershocks (8 events with magnitude between 5.0 and 5.7), located both ENE and WSW of the mainshock. The focal mechanism solution for the main events indicate transpressional faulting with reverse dip-slip and left-lateral kinematic components (USGS 2024), in agreement with the direction of active shortening of about 10 mm/yr in this sector of the Tian Shan Mountains (Molnar & Ghose 2000; Wang & Shen 2020). In addition, a recent study (Zhang et al. 2024) has highlighted a zone of surface ruptures (extending for about 2 km), possibly associated with a SE-dipping fault (thus dipping in the opposite direction compared to the main shock fault plane) that might be related to the MW 5.7 largest aftershock occurred on 29 January.

In this study, using Interferometric Synthetic Aperture Radar (InSAR) measurements (Sentinel-1 satellites), we constrained the geometry of the fault segment responsible for the seismic event, the coseismic slip distribution, and the source of the subsequent MW 5.7 aftershock deformation. Finally, we evaluated the potential state of stress of the unruptured portions of the causative fault as well as of adjacent fault segments, using the Coulomb stress failure function variations. Our findings indicate rupture along a transpressive left-lateral NNW dipping high-angle fault, associated with the Southern Tian Shan Fault alignment, likely the Maidan fault, with slip up to 3.5 m only occurring between 10 and 20 km depth. The modeling of the postseismic deformation that includes the MW 5.7 aftershock occurred on 29 January 2024, and that is located about 15 km to

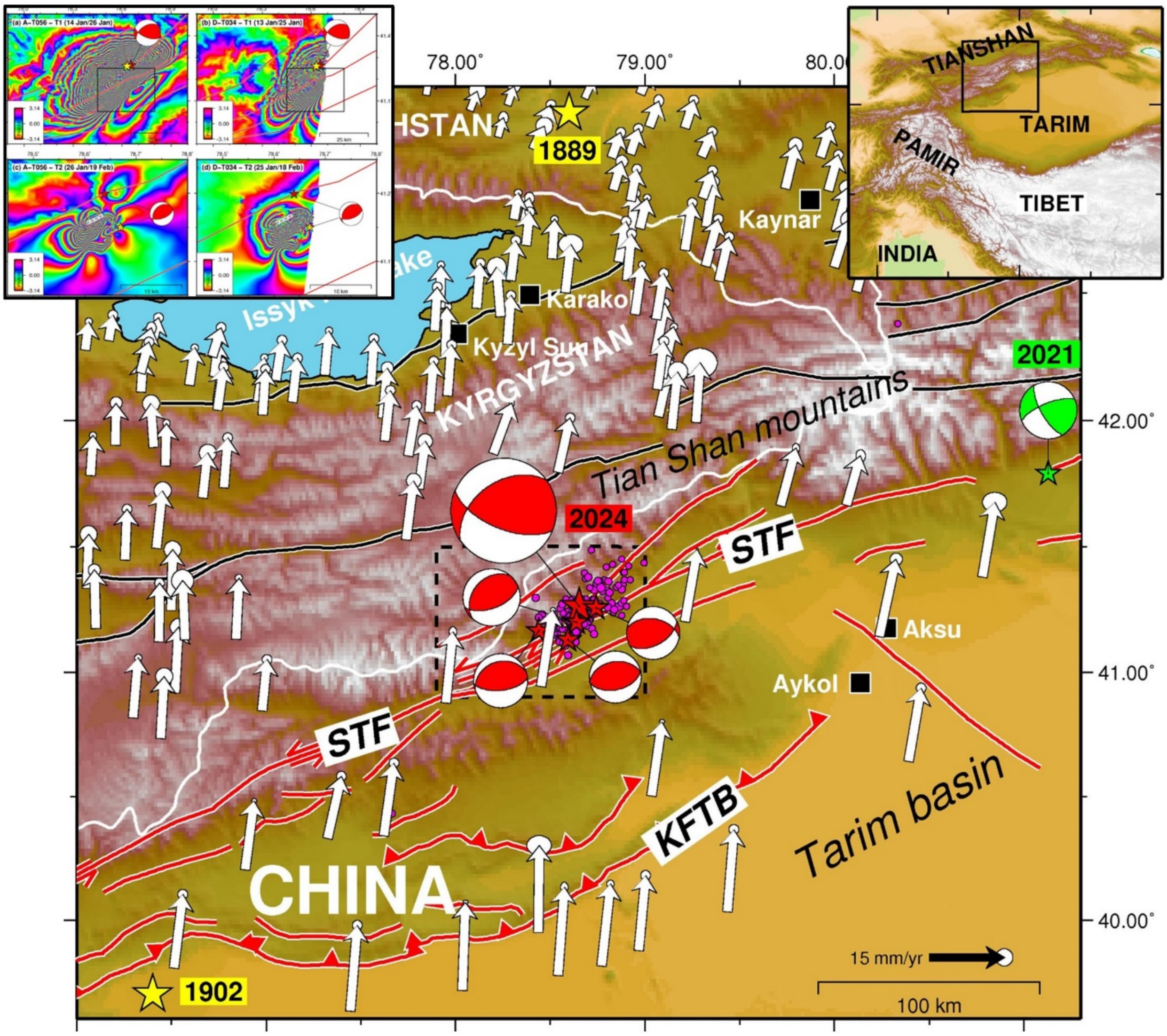

Fig. 1 – Seismotectonic framework. Solid barbed lines denote major tectonic lineaments (Wu et al. 2024). Seismicity: magenta dots indicate instrumental earthquakes from the United States Geological Survey catalog (USGS 2024); red stars represent significant shocks (M>5), including the 22 January 2024, MW 7.0 mainshock; the green star marks the 2021 MW 5.3 Baicheng transpressive earthquake, occurring NE of the 2024 seismic sequence on a high-angle fault segment along the front of the southern Tian Shan mountains (Yushan et al. 2022); the yellow stars are large (M>7) historical events. White arrows show the GPS velocity field in a Eurasian reference frame, illustrating the relative motion of the Tarim basin compared to the Kazakh platform (Wang & Shen 2020). The right upper inset presents a tectonic sketch of western China, with the box indicating the area of the main figure. The dashed box indicates the area of Figs 2 and 3. Abbreviations: KFTB= Kepingtage Fold-and Thrust Belt; STF=Southern Tianshan Fault. The left upper inset presents Sentinel-1 wrapped interferograms of the 22 January 2024, MW 7.0, Wushi mainshock (upper panels) and the 29 January 2024, MW 5.7 aftershock (bottom panels). The red and yellow stars are the mainshock provided by USGS and Liang et al. (2024), respectively, with its focal mechanism. In the bottom panels, the smaller red and yellow star represents the MW 5.7 aftershock that occurred on 29 January provided by USGS and Liang et al. (2024), respectively, with its focal mechanism. Solid lines are the major faults of the area (Wu et al. 2024). The black box in the upper panels indicates the area of the bottom panels. The gray dashed line in the postseismic (T2) interferograms indicates the location of the observed surface ruptures (Zhang et al. 2023).

the south of the mainshock, indicates a main patch with up to 90 cm of slip that may have occurred on a shallow back-thrust segment, in agreement with the observed surface breaks. Finally, based on the Coulomb stress distribution computation, we find that the MW 5.7 aftershock was likely triggered by the preceding mainshock and that the Wushi earthquake also increased the stress level at both terminations of the modeled fault plane, particularly along the southwestward continuation of the Maidan fault. In addition, we also find that a wide up-dip fault patch remained unruptured, and considering that these areas have been dynamically loaded it could represent potential further aseismic deformation and/or future significant ruptures, posing a continuing seismic hazard to Wushi County and surroundings areas.

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Corresponding author: daniele.cheloni@ingv.it