Preface to the volume 'Italian geophysics today'

This is the twenty-third volume collecting a group of selected papers presented during the annual national conference of the Gruppo Nazionale di Geofisica della Terra Solida (GNGTS) published in the Bulletin of Geophysics and Oceanography [BGO, formerly Bollettino di Geofisica Teorica ed Applicata (BGTA)]. It may be considered a sort of summary of the novelties arising during the congress.

GNGTS was established in 1978 as an offshoot of the Italian Consiglio Nazionale delle Ricerche to promote, develop, and coordinate research in the field of solid Earth geophysics. GNGTS comprised various sections: seismology, geodesy and gravimetry, geothermal research, crustal geophysics, mining and environmental geophysics, near-surface applications, as well as seismic exploration. In the past years, despite its limited budget, GNGTS funded several research activities and sponsored multi-disciplinary projects, mainly devoted to the study of the Earth's crust. About 500 researchers refer to the GNGTS and meet every autumn for a national assembly: a point of reference in the life of the Italian geophysics. Although the institution GNGTS was closed in December 2000, the GNGTS annual conference, sponsored by the Istituto Nazionale di Oceanografia e di Geofisica Sperimentale-OGS, continued to be held and reached its silver anniversary in 2006.

The GNGTS annual conference, which has been taking place for almost 40 years now, (Table 1) is the spontaneous meeting point for all researchers who work, even with different roles, in geophysics, seismology, geology, and volcanology, as well as all the scientific branches that collaborate to improve our knowledge of the solid Earth.

The Covid pandemic, that started in Italy in February 2020, interrupted arranging the 2020 conference but it was decided not to give up the organisation of the yearly successful event. For this reason, after the break in 2020, the 39th conference was organised in streaming mode. Despite the absence of participation in person, the 39th GNGTS conference still proved successful. The Scientific Technical Committee of the GNGTS, in organising the conference in online mode, wished to communicate a constructive reaction to the difficult situation caused by the pandemic. Similarly, the researchers, with their participation, have demonstrated their interest in carrying out research activities despite the obvious restrictions due to Covid. It is clear that an entirely online conference is more tiring and less appealing than a traditional conference because moments of researchers getting together, who take advantage of the conference to talk to each other and in some cases start new collaborations, are missing. In any case, thanks also to a considerable commitment by the technical staff of the OGS, the 3-day conference, with three parallel sessions, took place smoothly and without hitches. It was also possible to follow the conference through the YouTube channel, and videos of the full sessions were made available permanently on the YouTube channel.

It is important not to forget the fundamental role of GNGTS in its function as a 'training ground for young researchers' and the GNGTS Scientific Committee encourages the participation of young people in every way. Often, it is precisely at the GNGTS that the young or aspiring researchers present their first work. The traditional and anomalous free participation means that the conference is also open to all young doctoral students, fellows, contract, and aspiring researchers, who can participate in the conference by attending a scientific forum for the first time. Similarly, there is a great deal of attention to the participation of the university component of both teachers and students and for this reason, the possibility of attending a GNGTS conference in person is very important.

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During the general convention meeting, specific topics of general interest for the geophysical community are discussed and new activities are presented and the prizes of the Licio Cernobori Association for Geophysics (AGLC) are assigned. The AGLC, established on 30 October 2000 in remembrance of Licio Cernobori, a geophysicist who sadly died prematurely, aims at promoting geophysical studies, and above all the scientific training and the development of young researchers. This objective was initially pursued through the awarding of a study prize at the University of Trieste, also open to undergraduates/graduates in applied geophysics of other universities or scientific structures involved in joint projects with the University of Trieste. Since 2010, the AGLC has followed the tradition of assigning the prize to young speakers at the annual GNGTS congress, and the winners are announced and awarded during the general convention meeting. Since 2012, three prizes have been awarded to young researchers working in three main themes of GNGTS, which at the 39th congress were: Geodynamics, Seismic characterisation of the territory, and Applied geophysics

Table 1 - Locations of the annual GNGTS national conferences.

Conference	Year(s)	Location	Organising institution
1-26	1981-2007	Rome	La Sapienza University, Rome
27-28	2008-2009	Trieste	OGS, Trieste
29	2010	Prato	Istituto Geofisico Toscano
30	2011	Trieste	OGS, Trieste
31	2012	Potenza	Basilicata University, Potenza
32	2013	Trieste	OGS, Trieste
33	2014	Bologna	Emilia Romagna Region, Bologna
34	2015	Trieste	OGS, Trieste
35	2016	Lecce	CNR, Lecce
36	2017	Trieste	OGS, Trieste
37	2018	Bologna	Emilia Romagna Region, Bologna
38	2019	Roma	CNR, Roma
39	2021	In streaming	OGS, Trieste

Peer-reviewed proceedings of the national conferences have been published since 1997 in special volumes and on CD-ROMs, mainly in Italian. These documents are also available at the GNGTS website https://gngts.ogs.it. Since the year 2000, with the exceptions of 2012 to 2015, when the volumes of the proceedings of the conference were printed, it was decided to publish selected papers from the GNGTS conferences in an international geophysical journal, (the BGTA, now BGO) also in order to achieve a better dissemination of the GNGTS activities for an international audience.

Over the years, multidisciplinary and single-theme volumes have been issued (Table 2). The multidisciplinary volumes, which make up most of the published volumes, generally presented one paper from each of the sessions of the GNGTS conference. In this case, all three broad themes, i.e. Geodynamics, Seismic characterisation of the territory, and Applied geophysics, have been documented by a suite of papers. Conversely, the five thematic issues published up to now, have presented papers from a single GNGTS session that was of particular interest in the year of

presentation. In this way, one BGTA volume was devoted to the 2009 L'Aquila earthquake (Amato *et al.*, 2011), another to the GNGTS session concerning earthquake forecasting and hazard assessment (Albarello and Meletti, 2012), a third to the international session on the seismic hazard of the critical facilities (Grimaz and Slejko, 2014), a fourth referred to the session about science, technology, and communication to support seismic prevention (Dolce and Martelli, 2019), and a fifth focused on energy, related risks, and cascade effects (Martelli and Masi, 2021). A summary of the structure and activities of the GNGTS is described in a recent paper by Slejko (2020).

The present volume consists of 9 of the 125 papers presented orally or as posters during the 39th GNGTS national conference, held in streaming mode in 2021. The topics treated in this volume cover several themes of solid Earth geophysics, such as seismology, exploration geophysics, and engineering seismology. They present specific studies conducted in the Italian

Table 2 - The special issues of BGTA dedicated to selected papers from the GNGTS conferences.

N	Conference-year	Editor(s) (year)	Title	BGTA vol./issue
1	19-2000	Slejko (2002a)	Advances in Solid Earth geophysics	43/1-2
2	20-2001	Slejko (2002b)	More about Solid Earth Geophysics	43/3-4
3	21-2002	Marcellini *et al.* (2004)	More about regional and local seismic hazard in Italy	45/4
4	22-2003	Slejko and Rebez (2005)	A step forward in Solid Earth Geophysics	46/2-3
5	23-2004	Slejko and Rebez (2006)	New insights into Solid Earth Geophysics	47/1-2
6	24-2005	Slejko (2007)	Solid Earth Geophysics: a bit of this and a bit of that	48/2
7	25-2006	Slejko (2008)	Carlo Morelli's mission and passion: Geophysics	49/2
8	26-2007	Slejko (2009)	Pieces of Geophysics	50/2
9	27-2008	Slejko (2010)	Novelties in Geophysics	51/2-3
10	28-2009	Albarello and Slejko (2011a)	Geophysical research in Italy	52/2
11	28–2009	Amato *et al.* (2011)	The 2009 L'Aquila earthquake: geophysical insights from the 28th GNGTS Congress	52/3
12	28-2009	Albarello and Slejko (2011b)	Geophysics for prospecting, monitoring, and hazard assessment	52/4
13	28-2009	Albarello and Meletti (2012)	Earthquake forecasting and hazard assessment	53/1
14	29-2010	Cardarelli and Slejko (2012)	A little bit of Geophysics	53/3
15	29-2010	Rossi and Slejko (2012)	The Earth, its phenomena, and some related methods	53/4
16	30-2011	Grimaz and Slejko (2014)	Geophysics and critical facilities	55/1
17	35-2016	Persico and Slejko (2017)	Recent multi-topic geophysical investigations	58/4
18	36-2017	Dolce and Martelli (2019)	Science, technology and communication to support seismic prevention	60/2
19	36-2017	Rossi and Slejko (2020)	Geophysical solutions in environmental and natural hazard fields	61/1
20	37-2018	Volpi and Slejko (2020)	Geophysical approaches for subsurface investigation: Italian case studies	61/3
21	38/39-2018/2019	Martelli and Masi (2021)	Energy, related risks and cascade effects	62/2
22	39-2019	Rebez and Slejko (2021)	One small step to further our knowledge of the solid Earth	62/4

territory that also give important insights into the subsurface geological/geophysical structure and on the role of surficial geology in seismic risk assessment.

The first paper (Tertulliani and Graziani, 2022) proposes a review of the catastrophic seismic sequence that struck central Italy starting from January 1703, reconsidering the sequence on a chronological basis and seeking to reconstruct the impact of each one of the three mainshocks, considering the damage progression when assigning macroseismic intensity.

The study by Del Zoppo *et al.* (2022) presents a tsunami structural vulnerability model for Italian residential buildings based on numerical analysis and Monte Carlo simulation. Developed on the analytical vulnerability curves, tsunami vulnerability classes for Italian residential buildings are proposed to be used for an informed definition and prioritisation of risk mitigation strategies along the Italian and Mediterranean coasts.

The influence of local geological and soil conditions on ground motion and earthquake-induced damage is investigated in the third paper by Madiai *et al.* (2022). The main results drawn from an investigation into 2D aggravation effects in symmetric basins, overlain by two-layered linear visco-elastic deposits, are illustrated and useful indications are obtained for carrying out subsequent analyses aimed at developing simplified procedures for the inclusion of basin effects in design codes.

The paper by Compagnoni *et al.* (2022) illustrates the construction of abacuses for the semi-quantitative assessment of stratigraphic seismic amplification phenomena, applicable in the eastern Abruzzo region (central Italy). To prepare the abacuses, a procedure was adopted that took into consideration the geological analysis of the area, the collection of all the available geophysical and geotechnical data, the choice of the seismic inputs representative of the seismic hazard, the identification of the main seismic stratigraphic sequences, and the numerical analysis aimed at evaluating the amplification factors.

Masi and Nicodemo (2022) present in their paper a critical analysis of the 1980 Irpinia-Basilicata (southern Italy) post-earthquake phase, with particular attention to the Basilicata region. Furthermore, the evolution of countermeasures applied for reducing the vulnerability levels to earthquakes of some countries around the world are evaluated. Specifically, considering a time span of about 40 years (1980-2020), the data related to the number of deaths caused by earthquakes with respect to the population exposed has been analysed and some comparisons have been carried out. Although limited, since referring to a single risk indicator, the results confirm the close link between seismic consequences and socio-economic characteristics of the affected communities, as a poignant lesson for planning effective risk mitigation strategies.

The specific subject of glass behaviour under seismic load is treated in the sixth paper by Mattei and Bedon (2022). The authors verify the reliability of available simplified methods for glass systems during earthquakes, based on the definition of seismic response spectra, and help define a robust method to verify seismic capacity through the use of specific fragility curves.

The estimation of kerogen volume and quality in source rocks is fundamental for evaluating a basin's hydrocarbon potential. Methods for kerogen estimation are based upon chemical and mechanical analysis of rock samples from outcrops or cores, thus limiting the spatial accuracy of petroleum system models far from hard data. Recent works have demonstrated the possibility of using acoustic impedance inversion and amplitude versus angle analysis from surface seismic data for qualitative and quantitative estimation of kerogen in source rocks. These methods are discussed in detail in the paper by De Tomasi and Gambacorta (2022), and practical applications to real data are presented.

The anisotropy of sediments can be detected from S-wave seismic data, separating SH (orthogonal to the seismic line) and SV (parallel to the seismic line) wavefields. In their work,

Böhm *et al.* (2022) have analysed SV- and SH-wave data in order to estimate anisotropy from the comparison of the velocities of the SV and SH wavefields and to obtain information about the dip and strike angles of the anisotropic layers.

In the last paper of the present volume, Roncoroni *et al.* (2022) propose a procedure for the polarity assessment in reflection seismic data based on a Neural Network approach. The algorithm is based on a fully 1D approach, which does not require any input besides the seismic data since the necessary parameters are all automatically estimated. The algorithm is able to correctly extract the seismic horizons also in case of complex conditions, such as along the flanks of salt domes, and is able to track polarity inversions.

We wish to thank the convenors of the GNGTS sessions, who selected the papers for this volume, and M. Aleardi, C. Chisari, F. Da Col, C. Del Gaudio, A. D'Onofrio, F. Galadini, P. Galli, M. Giustiniani, S. Grimaz, F. Jalayer, M. Kozlowski, L. Martelli, C. Mascandola, A. Mazzotti, F. Pacor, A. Pagliaroli, and A. Tognarelli, who participated in the reviewing process of the papers.

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