

Curriculum Vitae – Umberta Tinivella



Istituto Nazionale di Oceanografia e di Geofisica Sperimentale
Borgo Grotta Gigante 42C, 34010 Trieste, Italy
Tel: +39 040 2140219, Fax: +39 040 327521
Email: utinivella@ogs.trieste.it

Brief profile

Since 1996 she is employed at OGS. In 1998 she received the Cagniard Award for the poster presented at the EAGE Conference. She performed simulation of acoustic wave propagation along the drill string considering the border condition (formation, mud, variable geometry, etc.). She studied the possibility to predict overpressure zones from analysis of seismic, log and laboratory data, by using elastic theories, which relate physical properties of rocks to pore pressure in the frame of EU project. In 2005, she received the Best Poster Presentation at the Near Surface Conference. Presently, she works on gas hydrate topic, considering standard and non-conventional processing of seismic data, such as pre-stack depth migration, Amplitude Versus Offset, seismic inversion, modeling and theoretical models to describe the physical properties of gas hydrate- and free gas-bearing sediments. She developed a procedure to estimate the concentrations of gas hydrate and free gas from seismic and well data. She is/was the leader of several Gas Hydrate Project supported by Italian government, oil company and EU. She is the author of many technical reports and papers on gas hydrate topic and she received several invitation to present her work. Moreover, she is active on divulgation of her research.

Keywords: gas hydrate, pore fluid, overpressure, modeling, advanced seismic processing, integrated geophysical approaches, theoretical modeling.

I have been working on gas hydrates since 1998 at the *Istituto Nazionale di Oceanografia e di Geofisica Sperimentale* (OGS, Italy) as a researcher. During the academic year 1994/95 I was an assistant researcher at the Physics Laboratory II at the *Ecole Polytechnique Federale de Losanne* (EPFL, Switzerland), where my main research was on numerical physics and solid state physics applied to random pseudo-binary ionic alloys. When I moved in OGS, I started to work on gas hydrate with interesting results. In fact, my gas hydrate research activity has given an important contribution to improve the knowledge about gas hydrate systems, often in close collaboration with the international gas hydrate community. In particular, I have developed theoretical models that describe the behaviour of compressional and shear velocity versus gas hydrate and free gas concentrations (at seismic and laboratory frequencies) and pore pressure (i.e. Tinivella, 2002). These models have been successfully applied to many gas hydrate studies (i.e. Chand et al., 2004). In addition, I developed a code to estimate gas hydrate and free gas concentrations, considering the effect of pore pressure in free gas zone. In this framework, a wider research activity has addressed many of the key issues relevant to the seismic data analysis, developing novel algorithms and software. For example, the ISTRICI (Structural Inversion by CIG Analysis) software was produced to obtain interval velocity by Common Image Gather (CIG) analysis adopting Seismic Unix (open source package) and home codes; the software has been distributed and trained to the Geoscience University (China) and the National Geophysical Research Institute (India) on the basis of bilateral collaborations. Moreover, a code to perform semiautomatic picking was created in order to reduce human time and to increase the objectivity of the picking before seismic analysis, such as tomographic inversion. A code to apply advanced seismic analysis (Amplitude

Versus Offset) based on theoretical AVO curves was also produced and used in several projects. Finally, I wish to mention that I improved my expertise in other fields during my PhD. In fact, the topic of my PhD research was the study of crustal land seismic data applying advanced techniques (such as AVO, pre-stack depth migration) in order to characterize a geothermal field. Moreover, I developed a code for simulating torsional and extensional waves in a real drill string and coupled waves in borehole and I participated to several projects (national and supported by EU) that integrate geophysical methods, such as electromagnetic and seismic data. My codes have been applied in many contests, not only in gas hydrate studies, including crustal seismic, geothermal fields and aquifer system analysis; the developed algorithms have been published in international journals. About 54 publications in the databases SCI-EXPANDED, SSCI, A&HCI and more than 70 papers in international journals, with increasing productivity during my carrier, testify the impact of my research in the scientific community and in particular in gas hydrate community. Currently, my H index is 12, if only databases SCI-EXPANDED, SSCI, A&HCI are considered, and equal to 17, considering all international papers (Google scholar website). Note that the field of applied geophysics is characterized by a relatively low number of citations, with top journals having relatively low impact factors (in 2009, Geophysics with IF=1.662, Geophysical Prospecting with IF=1.772). The impact of my research on the international community is also testified by a number of invited talks, the editorial work for journals, international awards (EAGE), the organizational work at international conferences and the recent invitation to contribute to the planning of the Korean Antarctic leg to acquire geophysical data in proximity of a gas hydrate reservoir. Established collaborations exist with colleagues from European and extra-European countries, within and beyond the existing funded projects, promoting international agreements. The scientific goals above have been accompanied by substantial organizational efforts, such as the planning of geophysical acquisition leg in Antarctica and collaborating to land acquisition planning for both 2D and 3D seismic. I was a tutor of diploma students, PhD students, Italian and European fellowships, including a Marie Curie fellowship focused on hydrate study in Mediterranean Sea. Finally, I have demonstrated a great flexibility at successfully change research field, starting my career in numerical and solid state physics (in years 1992 – 1995) and moving to gas hydrate (at the OGS since 1998), touching many aspect of geophysics, from the theoretical modelling to the advanced seismic analysis and simulation. This unusual career path has trained me to face constantly new challenges, and has strengthened substantially my capability to manage multidisciplinary research groups and tackle interdisciplinary scientific challenges.

Current position: Senior Researcher, Department of Lithosphere Geophysics, Istituto Nazionale di Oceanografia e di Geofisica Sperimentale – OGS. Reference person for gas hydrate research at OGS.

Employment:

- Since 1998: Researcher at OGS, permanent position from 2003
- 1996 - 1998: Fellowship at OGS
- 1994 - 1995: Assistant Research of the Physics Laboratory II at the Ecole Polytechnique Federale de Losanne (EPFL, Switzerland)
- 1993: Fellowship at National Institute of Material Physics (INFM; Italy)

Education:

- 2003 - 2005: PhD in Applied Geophysics at University of Trieste
- 1994 - 1995: specialization in Solid State Physics and Numerical Physics in the frame of the «Troisième cycle en Physique» at Ecole Polytechnique Federale de Losanne (EPFL, Switzerland)
- 1992: Laurea in Physics with laudem.

Main research interests:

My research is interdisciplinary, spanning the fields of seismic analysis, theory and modeling. Recently I have primarily focused on the study of:

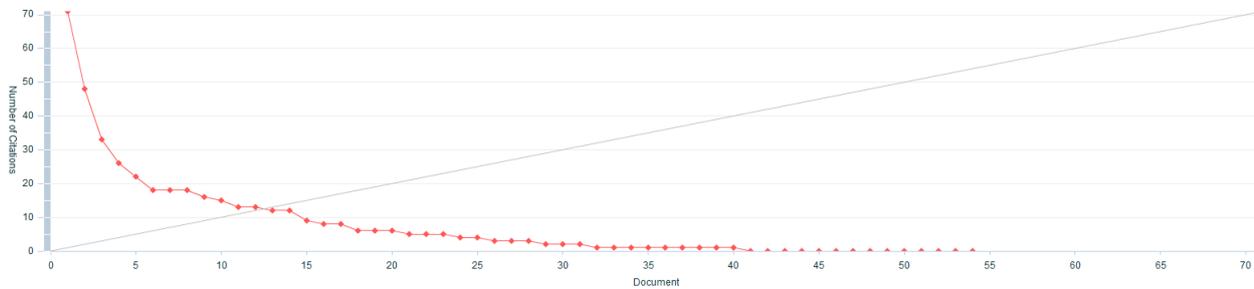
- Theoretical model to describe velocity versus gas hydrate and free gas concentrations and velocity versus pore pressure;
- Theoretical amplitude versus offset (AVO) curves to describe the effect of hydrate and free gas presence, overpressure condition and fluid presence in general;
- Seismic modeling to describe the seismic effect of hydrate and free gas presence and overpressure condition;

- Simulation of torsional, extensional and coupled waves in a borehole in order to better interpret well data;
- Advanced processing, such as datuming wave equation (WED) applied to crustal, high resolution land seismic, and Ocean Bottom Seismometer data;
- Algorithms and related codes to perform AVO and CIG (software named ISTRICI) analyses and to estimate the gas hydrate and free gas concentrations and the pore pressure regime (software named DRAGO);
- Integration analysis between different geophysical dataset.

The above studies are applied for different targets: characterization the gas hydrate reservoir, effect of climate change, and pressure/temperature change in general, on gas hydrate stability, characterization of aquifers, and analysis of crustal seismic data. The above mentioned analyses are also applied in environmental projects related to seismic risk. The developed procedures to analyze the seismic data have been the object of several invited talks and lessons. Moreover, the codes are disseminated in different contest in order to promote the collaboration with several countries (China, India, Norway, and Spain).

Summary research profile:

I have authored over 54 scientific papers in international refereed journals and more than 200 papers and talks for scientific conferences (from 1997 to 2011). My H index is 12 (from 1997 to 2013).



Selected service:

- **Management Committee** for EU-COST project “Permafrost and gas hydrate related methane release in Arctic and impact on climate change: European cooperation for long-term monitoring”;
- **Tutor:** Diploma in Environmental Engineering (M. Gili, 2011); PhD in Environmental Science (I. Vargas Cordero, 2006-2008; D. Accettella, 2009-2011); ICTP Fellowship (I. Vargas Cordero, 2007-2009); Fellowship at OGS (M.F. Loreto, 2005-2007); Marie Curie Fellowship (D. Praeg, 2004-2006); European grant in the frame of EURODOM (R.C. Neagu, 2004-2006); Diploma in Geology (F. Donda, 1998-1999)
- **International Agreements:** 1) Memorandum of Understanding between U. Tinivella and K. Sain (NGRI – India) to promote bilateral collaboration on gas hydrate studies (2010-2014); 2) Memorandum of Understanding between U. Tinivella e X. Liu (Geoscience University – China) to promote bilateral collaboration on gas hydrate studies (2009-2013); 3) Memorandum of Understanding between OGS e KOPRI (Korea) to collaborate in Antarctica (2007-2011).

Participation to data acquisition:

- Participation to Antarctic acquisition leg on board of Korean icebreaker Araon in proximity of a gas hydrate reservoir (December 2010);
- Participation to 3D land seismic data acquisition in proximity of a mud volcano (Apennines, Italy, 2005);
- Participation to 2D and 3D land data seismic to study aquifer system (Italy, 2005);
- P.I. of Antarctic acquisition (MCS and OBS data, multibeam, chirp, gravity core, CTD) leg to study gas hydrate (2004);
- Participation to Antarctic leg for crustal purposes (2004);
- Participation to seismic acquisition to characterize the shallow structures in Friuli Region (Italy) for seismic hazard (2004);
- Participation to Antarctic leg for crustal and gas hydrate studies (1997).

Recently funded research projects relevant to gas hydrate studies (P.I. U. Tinivella):

- *Relationship between climate change and gas hydrate offshore South Shetland Islands* (CLISM, 2010-2012). In collaboration with KOPRI (Korea). Supported by National Program of Research in Antarctica.

- *Collaboration of Mapping and Characterization of Gas Hydrate Reservoir in the South Chinese Sea* (2010-2012). In collaboration with Geoscience University (China) and supported by Italian-Chinese Governments.
- *Integrated analysis of geophysical data to characterize the gas hydrate reservoir offshore South Shetland Margin* (IAGARESS, 2007-2009). In collaboration with KOPRI (Korea). Supported by Italian- Korean Governments.
- *Mapping and quantification of gas hydrate in selected area of ENI interest* (MAQUAI, 2007). Service for Italian Oil company (ENI).
- *Integrated analysis of geophysical data to characterize slopes with gas hydrate offshore South Shetland Margin* (IGEOS; 2007-2010). In collaboration with KOPRI (Korea). Supported by National Program of Research in Antarctica.
- *Gas hydrate: environmental and climate impacts on sub-Antarctic regions* (BSR, 2003-2006). The project acquired geophysical data in Antarctica. Supported by National Program of Research in Antarctica.

Selected publications on the gas hydrate topic:

- U. Tinivella and M. Giustiniani (2013), Numerical simulation of coupled waves in borehole drilling BSR. *Marine and Petroleum Geology*, 44, 34-40. <http://dx.doi.org/10.1016/j.marpetgeo.2013.03.015>
- M.F. Loreto and U. Tinivella (2012). Gas hydrate versus geological features: the South Shetland case study. *Marine and Petroleum Geology*. 36, 164-171
- U. Tinivella, M. Giustiniani, X. Liu and I. Pecher (2012). Gas hydrate on continental margin. *Journal of Geological Research*, Article ID 781429, doi:10.1155/2012/781429
- U. Tinivella and M. Giustiniani (2012). Variations in BSR depth due to gas hydrate stability versus pore pressure. *Global and Planetary Change*, doi: 10.1016/j.gloplacha.2012.10.012
- M.F. Loreto and U. Tinivella (2012). Gas hydrate versus geological features: the South Shetland case study. *Marine and Petroleum Geology*. 36, 164-171
- U. Tinivella, M. Giustiniani, X. Liu and I. Pecher (2012). Gas hydrate on continental margin. *Journal of Geological Research*, Article ID 781429, doi:10.1155/2012/781429
- V. Volpi, D. Accettella, M. Giustiniani, and U. Tinivella (2011). New geophysical evidences of fluid related features in the western Ionian Sea - Data interpretation - Part II. *Journal of Energy and Power Engineering*, 1, 116-123
- M. Giustiniani, U. Tinivella, V. Volpi and D. Accettella (2011). New geophysical evidences of fluid related features in the western Ionian Sea - Advanced processing of old data - Part I. *Journal of Energy and Power Engineering*, 1, 46-53
- I. Cordero Vargas, U. Tinivella, F. Accaino, F. Fannucci, M.F. Loreto, M.E. Lascano and Cr. Reichert (2011). Basal and frontal accretion processes vs. BSR characteristics along the Chilean margin. *Journal of Geological Research*, Article ID 846101, 10 pages, doi:10.1155/2011/846101
- M.F. Loreto, U. Tinivella, F. Accaino, and M. Giustiniani (2011). Gas Hydrate Reservoir Characterization by Geophysical Data Analysis (Offshore Antarctic Peninsula). *Energies*, 4(1), 39-56; doi:10.3390/en4010039
- U. Tinivella, M. Giustiniani, and D. Accettella (2011). BSR versus climate change: example of preantarctic regions. *Journal of Geological Research*, Volume 2011, Article ID 390547, doi:10.1155/2011/390547
- I. Vargas Cordero, U. Tinivella, F. Accaino, M.F. Loreto, and F. Fannucci (2010). Thermal state and concentration of gas hydrate and free gas of Coyhaique, Chilean Margin (44°30' S). *Marine and Petroleum Geology*., 27, 1148-1156
- U. Tinivella, M.F. Loreto, and F. Accaino (2009). Regional versus detailed velocity analysis to quantify hydrate and free gas in marine sediments: the South Shetland Margin case study. *From: Sediment-Hosted Gas Hydrates: New Insights on Natural and Synthetic Systems*. Vol. 319, 103-119
- I. Vargas Cordero, U. Tinivella, F. Accaino, M.F. Loreto, F. Fannucci, and C. Reichert (2009). Analyses of bottom simulating reflections offshore Arauco and Coyhaique (Chile). *Geo-Mar Lett.*, DOI 10.1007/s00367-009-0171-5
- U. Tinivella, F. Accaino and B. Della Vedova (2008). Gas hydrates and active mud volcanism on the South Shetland continental margin, Antarctic Peninsula *GeoMarine Letters*, 28, 97-106, DOI 10.1007/s00367-007-0093-z
- F. Accaino, A. Bratus, S. Conti, D. Fontana and U. Tinivella (2007). Fluid seepage in mud volcanoes of the northern Apennines: An integrated geophysical and geological study. *J. Appl. Geoph.*; 63, 90 - 101.

- U. Tinivella (2002). The seismic response to overpressure versus gas hydrate and free gas concentration. *J. Seismic Exploration*, 11, 283-305
- U. Tinivella, F. Accaino, and A. Camerlenghi (2002). Gas hydrate and free gas distribution from inversion of seismic data on the South Shetland margin (Antarctica). *Marine Geophysical Research*, 23, 109-123
- U. Tinivella and F. Accaino (2000). Compressional velocity structure and Poisson's ratio in marine sediments with gas hydrate and free gas by inversion of reflected and refracted seismic data (South Shetland Islands, Antarctica). *Marine Geology*, 164, 13-27
- J.M. Carcione and U. Tinivella (2000). Bottom simulating reflectors: seismic velocities and AVO effects. *Geophysics*, 65, 54-67
- U. Tinivella (1999). A method for estimating gas hydrate and free gas concentrations in marine sediments. *Bollettino di Geofisica Teorica ed Applicata*, 40, 19-30

Selected publications on other topics:

- R. Catalano, V. Valenti, C. Albanese, F. Accaino, A. Sulli, U. Tinivella, M. Gasparo Morticelli, C. Zanolla, and M. Giustiniani (2013), Sicily's fold/thrust belt and slab roll-back: the S.I.R.I.PRO. seismic crustal transect *Journal of the Geological Society*, May 2013, v. 170:451-464, doi:10.1144/jgs2012-099
- E. Barison, G. Brancatelli, R. Nicolich, F. Accaino, M. Giustiniani, U. Tinivella (2011). Wave equation datuming applied to marine OBS data and to land high resolution seismic profiling. *Journal of Applied Geophysics*. doi:10.1016/j.jappgeo.2011.01.009
- M. Giustiniani, U. Tinivella, and F. Accaino (2010). P and S reflection and P refraction: An integration for characterising shallow subsurface. *Journal of Applied Geophysics*, 71, 149-156
- M. Giustiniani, F. Accaino, S. Picotti and U. Tinivella (2009). 3D seismic data for shallow aquifers characterisation. *Journal of Applied Geophysics*, 68: 394–403, doi:10.1016/j.jappgeo.2009
- R.C. Neagu, Tinivella, U., Volpi, V., Rebesco, M. & Camerlenghi (2008). Estimating the biogenic silica concentration and its effects on slope stability in marine sediments using seismic and log data from the sediment drift 7-Antarctica. *Int. J. E. Sci*, Doi 10.1007/s00531-008-0315-2
- M.F. Loreto, U. Tinivella, and C.R. Ranero (2007). Evidence for fluid circulation, overpressure and tectonic style along the Southern Chilean margin. *Tectonophysics*, 429, 183–200
- F. Accaino, U. Tinivella, G. Rossi, and R. Nicolich (2005). Geofluid evidences from analysis of seismic data from Southern Tuscany (Italy). *JVGR*, 148, 46– 59
- U. Tinivella and F. Poletto (2003). Propagation of extensional and torsional waves in a real drill string. *Journal of Seismic Exploration*, 12, 151-168
- U. Tinivella (2003). Numerical simulation of coupled waves in borehole. *J. Computational Acoustics*, 11, 1-14
- J.M. Carcione and U. Tinivella (2001). The seismic response to overpressure: a modelling study based on laboratory, well and seismic data. *Geophysical Prospecting*, 49, 523-539
- U. Tinivella (1998). Semi-automatic picking in real seismic data. *First Break*, 16, 47-51

Books:

- C. Giavarini, with the collaboration of A. Camerlenghi, F. Maccioni, G. Panieri, and U. Tinivella (2007). *Energia immensa e sfida ambientale. Gli idrati del metano*. Ed. Università la Sapienza, 192 pp
- J.M. Carcione, D. Gei, G. Rossi and U. Tinivella (2010). Wave theory, simulation and determination of gas-hydrate content in sediments. Chapter 25 in *Geophysical characterization of Gas hydrate*. Edited by M. Reidel, E.C. Willoughby and S. Chopra.
- U. Tinivella and M. Giustiniani (2012). An overview of mud volcanoes associated to gas hydrate system. Book title: *Volcanology* (ISBN 980-953-307-547-6).

Awards:

- 2005: Best Poster Presentation Award at the Near Surface Conference, 11th European EAGE Meeting of Environmental and Engineering Geophysics. “Evidences of slope instability caused by gas hydrate dissociation offshore Antarctic Peninsula” by U. Tinivella, F. Accaino, and B. Della Vedova
- 1998: Cagniard Award for the poster presented at the 60st European Association of Geoscientists and Engineers (EAGE) Conference. “Acoustic properties and AVO of Bottom Simulating Reflectors associated with gas hydrate” by J.M. Carcione and U. Tinivella

Selected invited presentations/lessons/courses

- Organization/participation Training School: “Permafrost and gas hydrate related methane release in Arctic and impact on climate change” (Finland, 2013)
- Course on the use of Seismic Unix and the software ISTRICI (code created to analyze CIG) at University of Geosciences, China (2 weeks, 2012)
- Lessons for PhD course in Geosciences: “Elastic properties of the rocks: AVO and theoretical approaches” and “Gas hydrate: from climate change to possible future energy” (Italy, 2011)
- Course on the use of GeoDepth (Paradigm Geophysical) at ICREA, Barcelona Center for Subsurface Imaging (CSIC), Spain (1 week, 2010)
- Lesson inside the Symposium on Non-Conventional Energy Generation from Coal and Gas Hydrates” at PUCRS-PETROBRAS (Porto Alegre, Brasil):”An approach to characterize the gas hydrate reservoir by geophysical analysis” (2010)
- Course on the use of Seismic Unix and the software ISTRICI (code created to analyze CIG) at NGRI, India (2 weeks, 2009)
- Invited talk at AOGS, entitled “Geophysical Data Analyses and GIS to Characterize the Gas Hydrate Reservoir” (2009)
- Lessons about the method used to analyze the seismic data in order to estimate the gas hydrate and free gas concentrations at Institute of Acoustics (Chinese Academy of Sciences, Beijing), Department of Geophysics and Information Technology (China University of Geosciences, Beijing), e University of Science and Technology (Qingdao, China). 2007
- Lessons in the frame of collaboration between Italy and Georgia: “3D seismic: Integrated analysis of geophysical methods” and “Petrophysical properties of the rocks” (2005)
- Invited talk at “New frontiers for unconventional hydrocarbons resources” organized by ENI (Italy), entitled: “Seismic prospecting and quantification of methane hydrates in marine sediments” (2003)
- Invited seminar on gas hydrate studies at Italian Institute of Madrid to promote joint collaboration (2002)
- Invite to participate at Third International Conference on Gas Hydrates, Salt Lake City, USA, as Italian expert on gas hydrate studies in collaboration with J.P. Henriot (Belgium), H. Amann (Germany), A. Skinner (France). 1999

Memberships to Editorials Boards of International Journals.

- Lead Guest Editor of special publication: “Geophysical Methods for Environmental Studies”, International Journal of Geophysics (2013)
- Lead Guest Editor of special publication: “Gas Hydrate on Continental Margins”, Journal of Geological Research (2011)
- member of Editorial Board of The Open Paleontology Journal (since 2008)

Organization of conferences:

- 1) EGU section ERE1.4 “Gas-hydrates, petroleum and coal - Resources and hazards” (Austria; 2010);
- 2) member of Scientific Committee of Fiery Ice Workshop (New Zealand, 2010); OMC section “Energy From Methane Hydrates – Resource Potential And Technology Challenges” (Italy, 2009);
- 3) GEOITALIA section “Gas hydrate from environmental impact to a possible energy resource” (Italy, 2009);
- 4) AOGS Gas hydrate section (Korea, 2008); workshop Italy-Korea to promote bilateral collaboration (Italy, 2008);
- 5) GEOITALIA section T02 “Gas hydrate from environmental impact to a possible energy resource” (Italy, 2007);
- 6) GEOITALIA section T15 “Effetti geologici associati ai gas idrati: esempi attuali e fossili” (Italy, 2005);
- 7) GNGTS section “Norme sismiche e caratterizzazione della risposta locale con metodologie geofisiche” (Italy, 2005)

Five mud volcanoes in Antarctic Peninsula are named by U. Tinivella after reviewer of Commission (2007-2008): Chjavalz, Flop, Grauzaria, Sernio, and Vualt.

SEG member, member of italian EAGE/SEG section