

## **Victoria J. Orphan**

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### **EDUCATION and TRAINING**

Postdoctoral:	NASA AMES RESEARCH CENTER National Research Council Associate <i>Advisor Dr. David DesMarais</i>	2002-2004
Graduate:	UNIVERSITY OF CALIFORNIA, SANTA BARBARA Ph.D. Ecology, Evolution, and Marine Biology <i>Thesis advisor: Dr. Edward F. DeLong</i>	1996-2001
Undergraduate:	UNIVERSITY OF CALIFORNIA, SANTA BARBARA Bachelor's Aquatic Biology	1990-1994
Other training:	MONTEREY BAY AQUARIUM RESEARCH INSTITUTE Graduate Research Assistant	1998-2001
	SFSU TIBURON CENTER FOR ENVIRONMENTAL STUDIES Research Technician	1994-1995

### **PROFESSIONAL EXPERIENCE**

CALIFORNIA INSTITUTE OF TECHNOLOGY, PASADENA, CA Allen V.C. Davis and Lenabelle Davis Leadership Chair, CEMI	2020-present
CALIFORNIA INSTITUTE OF TECHNOLOGY, PASADENA, CA James Irvine Professor of Environmental Science and Geobiology	2016-present
CALIFORNIA INSTITUTE OF TECHNOLOGY, PASADENA, CA Professor of Geobiology, Division of Geological and Planetary Sciences	2010-present
CALIFORNIA INSTITUTE OF TECHNOLOGY, PASADENA, CA Associate Professor of Geobiology, Division of Geological and Planetary Sciences	2010
CALIFORNIA INSTITUTE OF TECHNOLOGY, PASADENA, CA Assistant Professor of Geobiology, Division of Geological and Planetary Sciences	2004-2010
MONTEREY BAY AQUARIUM RESEARCH INSTITUTE, MOSS LANDING, CA Adjunct Scientist	2008-present
MBL MICROBIAL DIVERSITY COURSE, WOODS HOLE, MA Faculty in residence	2009

## **HONORS & REGOGNITION**

Fellow American Academy of Arts and Sciences (AAAS)	2020
Director Caltech Center for Environmental Microbial Interactions (CEMI)	2020
CIFAR Fellow	2019
U Bremen Excellence Chair	2019
NOMIS Distinguished Scientist	2018
Cozzarelli Prize – PNAS, Applied Biological, Agricultural, and Environmental Sciences	2017
MacArthur Fellow	2016
Fellow American Academy of Microbiology	2015
Fred Shair Diversity Award (Caltech Center for Diversity)	2014
Investigator Gordon and Betty Moore foundation Marine Microbiology Initiative	2013
Young investigator award: International Society of Microbial Ecology (ISME)	2012
Presidential Early Career Award in Science and Engineering (PECASE)	2011
GAST Lectureship, European Association of Geochemistry	2011
DOE Early Career Research Award	2010
Gordon and Betty Moore Foundation Young Investigator	2005
National Research Council Fellow, NASA Ames Research Center	2001

### **(d) Representative Synergistic Activities**

- Committee member President's Diversity Council and GPS Diversity Equity and Inclusion
- Chair elect: microbial C1 metabolism Gordon Research conference (July 2018)
- Invited lecturer and faculty in Residence, MBL Microbial Diversity Course (2008-2012 and 2014- 2017)
- Director Caltech's Kerckhoff Marine Laboratory (2017-present)
- Co-Director Agouron and Simons Foundation International Geobiology summer course (2018-present)
- Journal Editor for *Environmental Microbiology* (2012-2016)

### **Graduate Advisors and Postdoctoral Sponsors**

Edward DeLong (current U. of Hawaii) and David DesMarais (NASA Ames Research Center)

#### **Ph.D. Graduate Student Supervision**

Current: R. Wipfler (2<sup>nd</sup> year, Geobiology), S. Parra (3<sup>rd</sup> year, Geobiology), Y. Guo (3<sup>rd</sup> year Environmental Science and Engineering); A. Narayanan (4<sup>th</sup> year Biology), S. Lim (6<sup>th</sup> year Geobiology)

Co-advised: S. Silverman (3<sup>rd</sup> year, Geobiology), S. Esswein (4<sup>th</sup> year Biology Md/PhD), C. Sanders (5<sup>th</sup> year Planetary Science/Geobiology); U. Lingappa (6<sup>th</sup> year Geobiology).

Previous: G. Chadwick, (2020, Geobiology), K. Metcalfe (2020, Geobiology), S. Mullin (2020, Geobiology), H. Yu (2017, Environmental Science and Engineering, postdoc Caltech), P. Magyar (2017, geochemistry postdoc Switzerland), E. Trembath-Reichert (2016, Geobiology, postdoc WHOI, assist. professor ASU in 2019), D. Case (2016, Geochemistry), J. Marlow (2015, Geobiology, Harvard postdoc, Assist. Professor Boston Univ.), A. Green-Saxena (2013, Biology), A. Dekas (2013, Geobiology, Assist. Professor Stanford), B. Harrison (2012, Geochemistry), C. Gammon (2008, Geobiology Masters), K. Turk (2005, Geobiology Masters)

#### **Postdoctoral Scholar Supervision**

Current: Yanzhe Zhu (2021-present); Rodney Tollerson (2021-present); Rafa Laso-Perez (2020-present); Kriti Sharma (2020-present); Alon Philosof (2018-present); Yamini Jangir (2018-present); Antoine Crème (2017-present), Fabai Wu (2017-present), Ranjani Murali (2017-present); Daan Speth (2016-2021).

Previous: Haley Sapers (2016-2020, Univ. York), K. Dawson (2012-2017, assist. Professor Rutgers), A. Pasulka (2013-2017 assist. Professor Cal Poly SLO), C. Skennerton (2014-2017, industry); R. Hatzenpichler (2011-2016, Assist. Professor Montana State University), S. McGlynn (2011-2014, professor, ELSI, Tokyo Tech), E. Wilbanks (2014-2016 assist. Professor UCSB), S. Scheller (2013-2016, assist. Professor University Helsinki), D. Smith (2013-2016, postdoc Wash U), J. Steele (microbiologist, Southern California Coastal Water Research Project), J. Glass (assistant professor Georgia Tech), D. Fike (associate professor Washington University), J. Bailey (assoc. professor University of Minnesota), R. Poretsky (assist. professor University of Illinois at Chicago), O. Mason (assist. professor, Florida state), A. Pernthaler (Group Leader Hemholtz center, Leipzig), H. Zhang (Research assistant professor, Virginia Tech).

## **REFEREED PUBLICATIONS** ([orcid.org/0000-0002-5374-6178](https://orcid.org/0000-0002-5374-6178))

### **2021**

- 1) Sim, M.S., Skennerton, C.T. and **Orphan, V.J.**, 2021. Physiological, genomic, and sulfur isotopic characterization of methanol metabolism by *Desulfovibrio carbinolicus*. PloS one, 16(1), p.e0245069.
- 2) Philips, A, D. Speth, et al. (in press) Microbial succession and dynamics in meromictic Mono Lake, California. Geobiology.
- 3) He, X, G. Chadwick, F. Jimenez, V. Orphan, C. Miele (In press) Spatially Resolved Electron Transport through Anode-Respiring Geobacter sulfurreducens Biofilms: Controls and Constraints. ChemElectroChem. DOI: 10.1002/celec.202100111R1

### **2020**

- 4) Metcalfe, K.S., Murali, R.S., Mullin, S.W., Connon, S.A. and **Orphan, V.J.**, (2020) Experimentally-validated correlation analysis reveals new anaerobic methane oxidation partnerships with consortium-level heterogeneity in diazotrophy. The ISME Journal 1-20.
- 5) Fincker, M., Huber, J.A., **Orphan, V.J.**, Rappé, M.S., Teske, A. and Spormann, A.M., 2020. Metabolic strategies of marine subseafloor Chloroflexi inferred from genome reconstructions. Environmental Microbiology. 8:3188-3204
- 6) Goffredi, S.K., Tilic, E., Mullin, S.W., Dawson, K.S., Keller, A., Lee, R.W., Wu, F., Levin, L.A., Rouse, G.W., Cordes, E.E. and **Orphan, V.J.**, 2020. Methanotrophic bacterial symbionts fuel dense populations of deep-sea feather duster worms (Sabellida, Annelida) and extend the spatial influence of methane seepage. Science Advances, 6(14), p.eaay8562.
- 7) Houghton, J.L., Jones, C., Dawson, K.S., **Orphan, V.**, Gomes, M.L. and Fike, D.A., 2020. Resolving micron-scale heterogeneity in porewater  $\delta^{34}\text{S}(\text{H}_2\text{S})$  by combining films for in-situ sulfide capture and secondary ion mass spectrometry. Marine Chemistry. in press.
- 8) Leu, A.O., Cai, C., McIlroy, S.J., Southam, G., **Orphan, V.J.**, Yuan, Z., Hu, S. and Tyson, G.W., 2020. Anaerobic methane oxidation coupled to manganese reduction by members of the Methanoperedenaceae. The ISME journal, 14(4), pp.1030-1041.

### **2019**

- 9) Chadwick, G. L., Jiménez-Otero, F., Gralnick, J. A., Bond, D. R., **Orphan, V. J.** (2019). NanoSIMS imaging reveals metabolic stratification within current-producing biofilms. PNAS 116(41), pp.20716-20724.

- 10) e Drigo, R.A., Lev-Ram, V., Tyagi, S., Ramachandra, R., Deerinck, T., Bushong, E., Phan, S., **Orphan, V.**, Lechene, C., Ellisman, M.H. and Hetzer, M.W., 2019. Age Mosaicism across Multiple Scales in Adult Tissues. *Cell Metabolism* 30:343-351e3.
- 11) Bublitz, D.C., Chadwick, G.L., Magyar, J.S., Sandoz, K.M., Brooks, D.M., Mesnage, S., Ladinsky, M.S., Garber, A.I., Bjorkman, P.J., **Orphan, V.J.** and McCutcheon, J.P., 2019. Peptidoglycan production by an insect-bacterial mosaic. *Cell*, 179(3), pp.703-712.
- 12) Cavicchioli, R., Ripple, W. J., Timmis, K. N., Azam, F., Bakken, L. R., Baylis, M., ... **V. Orphan...** & Crowther, T. W. (2019). Scientists' warning to humanity: microorganisms and climate change. *Nature Reviews Microbiology*, 17: 569-586.
- 13) Bird, L.R., Dawson, K.S., Chadwick, G.L., Fulton, J.M., Orphan, V.J. and Freeman, K.H., 2019. Carbon isotopic heterogeneity of coenzyme F430 and membrane lipids in methane-oxidizing archaea. *Geobiology*, 17(6), pp.611-627.
- 14) Sim, M.S., Ogata, H., Lubitz, W., Adkins, J.F., Sessions, A.L., Orphan, V.J. and McGlynn, S.E., 2019. Role of APS reductase in biogeochemical sulfur isotope fractionation. *Nature communications*, 10(1), p.44.
- 15) Stamenković, V., L. W. Beegle, K. Zacny, D. D. Arumugam, P. Baglioni, N. Barba, J. Baross, ... **V. Orphan**, &.... (2019) The next frontier for planetary and human exploration. *Nature Astronomy*. 3, no. 2: 116.
- 16) Sapers, H.M., Razzell Hollis, J., Bhartia, R., Beegle, L.W., **Orphan, V.J.** and Amend, J.P., 2019. The cell and the sum of its parts: patterns of complexity in biosignatures as revealed by deep UV Raman spectroscopy. *Frontiers in microbiology*, 10, p.679.
- 17) Boyd, J.A., Jungbluth, S.P., Leu, A.O., Evans, P.N., Woodcroft, B.J., Chadwick, G.L., **Orphan, V.J.**, Amend, J.P., Rappé, M.S. and Tyson, G.W., 2019. Divergent methyl-coenzyme M reductase genes in a deep-subseafloor Archaeoglobi. *The ISME journal*, 13(5), p.1269.

## 2018

- 18) Chadwick, G, J. Hemp, W. Fischer, V. J. Orphan (2018) Convergent evolution of unusual complex I homologs with increased proton pumping capacity: energetic and ecological implications. *ISMEJ*. 12:2668.
- 19) Yu, H., Susanti, D., McGlynn, S.E., Skennerton, C.T., Chourey, K., Iyer, R., Scheller, S., Tavormina, P.L., Hettich, R.L., Mukhopadhyay, B. and **Orphan, V.J.**, 2018. Comparative Genomics and Proteomic Analysis of Assimilatory Sulfate Reduction Pathways in Anaerobic Methanotrophic Archaea. *Frontiers in microbiology*, 9.
- 20) Yung, Y. L., P. Chen, K. Nealson, S. Atreya, P. Beckett, J. G. Blank, B. Ehlmann...**V. Orphan...** et al. "Methane on Mars and Habitability: Challenges and Responses." (2018): 1221-1242.
- 21) Speth, D and **V.J. Orphan** (2018) Metabolic marker gene mining provides insight in global mcrA diversity and, coupled with targeted genome reconstruction, sheds further light on metabolic versatility potential of the Methanomassiliicoccales. *PeerJ*
- 22) Ijiri, A et al., (2018) Deep-biosphere methane production stimulated by geofluids in the Nankai accretionary complex. *Science Advances*. 4(6) eaao4631
- 23) McGlynn, S.E., Chadwick, G.L., O'Neill, A., Mackey, M., Thor, A., Deerinck, T.J., Ellisman, M.H. and **V.J. Orphan**. 2018. Subgroup characteristics of marine methane-oxidizing ANME-2 archaea and their syntrophic partners revealed by integrated multimodal analytical microscopy. *Applied and Environmental Microbiology*, pp.AEM-00399.
- 24) Dekas, A.E., Fike, D.A., Chadwick, G.L., Green-Saxena, A., Fortney, J., Connon, S.A., Dawson, K.S. and **Orphan, V.J.**, 2018. Widespread nitrogen fixation in sediments from diverse deep-sea sites of elevated carbon loading. *Environmental microbiology*, 20(12), pp.4281-4296.
- 25) Michel, A.J., Ward, L.M., Goffredi, S.K., Dawson, K.S., Baldassarre, D.T., Brenner, A., Gotanda, K.M., McCormack, J.E., Mullin, S.W., O'Neill, A. and Tender, G.S., J. A. Uy, K. Yu, **V.J. Orphan** and J. Chavez. 2018. The gut of the finch: uniqueness of the gut microbiome of the Galápagos vampire finch. *Microbiome*, 6(1), p.167.

## 2017

- 26) Case, D, A Ijiri, Y Morono, P Tavormina, **V Orphan**, F Inagaki (2017) Aerobic and anaerobic methanotrophic communities associated with methane hydrates exposed on the seafloor: A high-pressure sampling and stable isotope-incubation experiment. *Frontiers in Microbiology*. 8: 2569
- 27) Pasulka, A.L., Thamatrakoln, K., Kopf, S.H., Guan, Y., Poulos, B., Moradian, A., Sweredoski, M.J., Hess, S., Sullivan, M.B., Bidle, K.D. and **Orphan, V.J.**, 2017. Interrogating marine virus-host interactions and elemental transfer with BONCAT and nanoSIMS-based methods. *Environmental microbiology*. 20(2), pp.671-692.
- 28) Fike, D.A., J.L. Houghton, S.E. Moore, W.P. Gilhooly III, K.S. Dawson, G.K. Dreshel, J.P. Amend, and **V. J. Orphan** (2017) Spatially resolved capture of hydrogen sulfide from the water column and sedimentary pore waters for abundance and stable isotopic analysis. *Marine Chemistry*. 197: 26-37
- 29) Trembath-Reichert, E., Y. Morono, A. Ijiri, T. Hoshino, K.S Dawson, F. Inagaki and **V. J. Orphan** (2017). Methyl compound use and slow growth characterize life in 2-km-deep subseafloor coal beds. *Proceedings of the National Academy of Sciences*. 114:e9206-9215
- 30) Marlow, J.J., Steele, J.A., Ziebis, W., Scheller, S., Case, D., Reynard, L.M. and **Orphan, V.J.**, 2017. Monodeuterated Methane, an Isotopic Tool To Assess Biological Methane Metabolism Rates. *mSphere*, 2(4), pp.e00309-17.
- 31) Zhu, Y., Zhao, R., Piehowski, P.D., Moore, R.J., Lim, S., **Orphan, V.J.**, Paša-Tolić, L., Qian, W.J., Smith, R.D. and Kelly, R.T. (2017). Subnanogram proteomics: impact of LC column selection, MS instrumentation and data analysis strategy on proteome coverage for trace samples. *International Journal of Mass Spectrometry*.
- 32) Sim, M-S, G. Paris, J.F. Adkins, **V.J. Orphan**, and A.L Sessions (2017). Quantification and isotopic analysis of intracellular sulfur metabolites in the dissimilatory sulfate reduction pathway. *Geochimica et Cosmochimica Acta*. 106:57-72.
- 33) Skennerton, C.T., Chourey, K., Iyer, R., Hettich, R.L., Tyson, G.W. and **Orphan, V.J.**, 2017. Methane-Fueled Syntrophy through Extracellular Electron Transfer: Uncovering the Genomic Traits Conserved within Diverse Bacterial Partners of Anaerobic Methanotrophic Archaea. *mBio*, 8(4), pp.e00530-17.
- 34) Smith, D, A. Sessions, N. Dalleska, and **V.J. Orphan** (2017). Rapid Quantification and Isotopic Analysis of Dissolved Sulfur Species. *Rapid Communications in Mass Spectrometry*. 31:791-803
- 35) Pasulka, A.L., Goffredi, S.K., Tavormina, P.L., Dawson, K.S., Levin, L.A., Rouse, G.W. and **Orphan, V.J.**, 2017. Colonial tube-dwelling ciliates influence methane cycling and microbial diversity within methane seep ecosystems. *Frontiers in Marine Science*, 3, p.276.
- 36) Terrado, R, Pasulka, A.L., Lie, A.A.Y., **Orphan, V.J.**, Heidelberg, K.B. and Caron, D.A. 2017. Autotrophic and heterotrophic acquisition of carbon and nitrogen by a mixotrophic chrysophyte established through stable isotope analysis. *ISMEJ*. 11:2022.
- 37) Glass, J.B., Chen, S., Dawson, K.S., Horton, D.R., Vogt, S., Ingall, E.D., Twining, B.S. and **Orphan, V.J.**, 2017. Trace metal imaging of sulfate-reducing bacteria and methanogenic archaea at single-cell resolution by synchrotron X-ray fluorescence imaging *Geomicrobiology Journal*, pp.1-9.
- 38) Tavormina, P. L. and Kellermann, M. Y. and Antony, C P., Dublier, N., and **Orphan, VJ.** (2017) Starvation and recovery in the deep-sea methanotroph *Methyloprofundus sedimenti*. *Molecular Microbiology*. 103:242-252.

## 2016

- 39) Hatzenpichler, R., Connon, S.A., Goudeau, D., Malmstrom, R.R., Woyke, T. and **Orphan, V.J.**, 2016. Visualizing in situ translational activity for identifying and sorting

slow-growing archaeal– bacterial consortia. *Proceedings of the National Academy of Sciences*, 30(17), 1923-1940.

- 40) Magyar, P., **Orphan, V.** and Eiler, J., 2016. Measurement of rare isotopologues of nitrous oxide by high-resolution multi-collector mass spectrometry. *Rapid Communications in Mass Spectrometry*, 76(6): 2054-2054
- 41) Dawson, K. S., Scheller, S., Dillon, J. G., and **Orphan, V. J.** (2016). Stable isotope phenotyping via cluster analysis of NanoSIMS data as a method for characterizing distinct microbial ecophysiologicals and sulfur-cycling in the environment. *Frontiers in Microbiology*, 7, 774
- 42) Miranda, P. J. and McLain, N. K. and Hatzepichler, R., **V.J. Orphan** and J. Dillon (2016) Characterization of Chemosynthetic Microbial Mats Associated with Intertidal Hydrothermal Sulfur Vents in White Point, San Pedro, CA, USA. *Frontiers in Microbiology*, 7, 1163
- 43) Trembath-Reichert, E., Case, D. H., and **Orphan, V. J.** (2016). Characterization of microbial associations with methanotrophic archaea and sulfate-reducing bacteria through statistical comparison of nested Magneto-FISH enrichments. *PeerJ*, 4, e1913.
- 44) Fradet, D. , P. Tavormina and **V. J. Orphan** (2016) Members of the methanotrophic genus *Methylomarinum* inhabit inland mud pots. *PeerJ*. 4 p.e2116
- 45) Scheller, S H. Yu, G. Chadwick, S. McGlynn, and **V.J. Orphan** (2016) Artificial electron acceptors decouple archaeal methane oxidation from sulfate reduction. *Science*. 351(6274), pp.703-707.
- 46) Kopf, S., A. L. Sessions, E. Cowley, C. Reyes, L. VanSambeek, Y. Hu, **V. J. Orphan**, R. Kato, & D. Newman (2016) Trace incorporation of heavy water reveals slow and heterogeneous pathogen growth rates in cystic fibrosis sputum. *Proc. Natl. Acad. Sci. USA*. 113:110-116.
- 47) Skennerton, C., M. Haroon, A. Briegel, J. Shi, G. Jensen, G. Tyson, and **V. J. Orphan** (2016). Phylogenomic Analysis of Candidatus 'Izimaplasma' species: Free-living representatives from a *Tenericutes* Clade found in Methane Seeps. *ISMEJ*
- 48) Marlow, J, C. Skennerton, Z. Li, K. Chourey, R. Hettich, C. Pan, **V. J. Orphan** (2016) Proteomic Stable Isotope Probing Reveals Biosynthesis Dynamics of Slow Growing Methane Based Microbial Communities. *Frontiers in Microbiology*.7.

## 2015

- 49) McGlynn, S, G. Chadwick, C. Kempes, & **V.J. Orphan** (2015) Single cell activity reveals direct electron transfer in methanotrophic consortia. *Nature*. 526:531-535.
- 50) Evans, P. N., Parks, D. H., Chadwick, G. L., Robbins, S. J., **Orphan, V. J.**, Golding, S. D., & Tyson, G. W. (2015). Methane metabolism in the archaeal phylum Bathyarchaeota revealed by genome-centric metagenomics. *Science*, 350(6259), 434-438.
- 51) Dekas, A.E., Connon, S.A., Chadwick, G.L., Trembath-Reichert, E. and **Orphan, V.J.**, 2015. Activity and interactions of methane seep microorganisms assessed by parallel transcription and FISH-NanoSIMS analyses. *The ISME journal*. 10:678-692.
- 52) Pasulka, A.L., Levin, L.A., Steele, J.A., Case, D.H., Landry, M.R. and **Orphan, V.J.**, 2015. Microbial eukaryotic distributions and diversity patterns in a deep-sea methane seep ecosystem. *Environmental microbiology*.
- 53) Case, D., A. Pasulka, J. Marlow, B. Grupe, L. Levin & **V. J. Orphan** (2015) Methane Seep Carbonates Host Distinct, Diverse, and Dynamic Microbial Assemblages. *mBio*. 6:6
- 54) Skennerton, C.T., Ward, L.M., Michel, A., Metcalfe, K., Valiente, C., Mullin, S., Chan, K.Y., Gradinaru, V. and **Orphan, V.J.**, 2015. Genomic reconstruction of an uncultured hydrothermal vent gammaproteobacterial methanotroph (family Methylothermaceae) indicates multiple adaptations to oxygen limitation. *Frontiers in Microbiology*, 6, p.1425.
- 55) Mason, O.U., Case, D.H., Naehr, T.H., Lee, R.W., Thomas, R.B., Bailey, J.V. and **Orphan, V.J.**, 2015. Comparison of archaeal and bacterial diversity in methane seep

carbonate nodules and host sediments, Eel River Basin and Hydrate Ridge, USA. *Microbial ecology*, 70(3), pp.766-784.

- 56) Druschel, G and **V. J. Orphan** "Cultivation, In situ measurements, and geochemical techniques for Geomicrobiological studies" pp 157. In: Ehrlich's Geomicrobiology 6<sup>th</sup> ed. Eds: Ehrlich, H, D. Newman, and A. Kappler. Taylor and Francis Group. 2016.
- 57) Dawson, K. S., Osburn, M. R., Sessions, A. L., & **Orphan, V. J.** (2015). Metabolic associations with archaea drive shifts in hydrogen isotope fractionation in sulfate-reducing bacterial lipids in cocultures and methane seeps. *Geobiology*. 13:462-477.
- 58) Hatzenpichler, R., & **Orphan, V. J.** (2015). Detection of Protein-Synthesizing Microorganisms in the Environment via Bioorthogonal Noncanonical Amino Acid Tagging (BONCAT). In: *Hydrocarbon and Lipid Microbiology Protocols*, Springer Protocols Handbooks. DOI:10.1007/8623\_2015\_61
- 59) Marlow, JJ, J. Peckmann, & V. J. **Orphan** (2015). Autoendoliths: A Distinct Type of Rock-Hosted Microbial Life. *Geobiology*. 13:303-307.
- 60) Bryson S, Correa AS, Thurber AR, **Orphan, V**, Vega Thurber, R. (2015) A novel sister clade to the Enterobacteria microviruses (family Microviridae) identified in methane seep sediments. *Environmental Microbiology*. 17: 3708-3721.
- 61) Kopf, S. H., McGlynn, S. E., Green-Saxena, A., Guan, Y., Newman, D. K., & **Orphan, V. J.** (2015). Heavy water and <sup>15</sup>N labeling with NanoSIMS analysis reveals growth-rate dependent metabolic heterogeneity in chemostats. *Environmental Microbiology*. DOI: 10.1111/1462-2920.12752
- 62) Tavormina, P. L., Hatzenpichler, R., McGlynn, S., Chadwick, G., Dawson, K. S., Connon, S. A., & **Orphan, V. J.** (2015). *Methyloprofundus sedimenti* gen. nov., sp. nov., an obligate methanotroph from ocean sediment belonging to the 'deep sea-1' clade of marine methanotrophs. *International journal of systematic and evolutionary microbiology*, 65(Pt 1), 251-259.

## 2014

- 63) Inagaki, F and **V. Orphan** (2014) Exploration of subseafloor life and the biosphere through IODP (2003-2013). In: *Developments in Marine Geology Volume 7* Eds. R. Stein, D. Blackman, F. Inagaki, H-C. Larsen. Elsevier, Oxford UK.
- 64) Sivan, O, G. Antler, A.V. Turchyn, J.J. Marlow, and **V. J Orphan** (2014). Iron oxides stimulate sulfate-driven anaerobic methane oxidation in seeps. *Proc. Natl. Acad. Sci USA*. [www.pnas.org/cgi/doi/10.1073/pnas.1412269111](http://www.pnas.org/cgi/doi/10.1073/pnas.1412269111)
- 65) Marlow, J.J, J. A Steele, D. H Case, S. A Connon, L.A Levin and **V. J. Orphan** (2014). Microbial abundance and diversity patterns associated with sediments and carbonates from the methane seep environments of Hydrate Ridge, OR. *Front. Mar. Sci.* doi: 10.3389/fmars.2014.00044
- 66) Marlow, JJ., J. A. Steele, W. Ziebis, A. R. Thurber, L.A. Levin, **V.J. Orphan** (2014). Carbonate-hosted methanotrophy represents and unrecognized methane sink in the deep sea. *Nat. Comm.* 5:5094 DOI: 10.1038/ncomms6094
- 67) Marlow, J. J., LaRowe, D. E., Ehlmann, B. L., Amend, J. P., & **Orphan, V. J.** (2014). The potential for biologically catalyzed anaerobic methane oxidation on ancient Mars. *Astrobiology*, 14(4), 292-307.
- 68) Hatzenpichler, R., Scheller, S., Tavormina, P. L., Babin, B. M., Tirrell, D. A., & **Orphan, V. J.** (2014). In situ visualization of newly synthesized proteins in environmental microbes using amino acid tagging and click chemistry. *Environmental Microbiology*. 16:2568-2590
- 69) Crespo-Medina, M., Meile, C. D., Hunter, K. S., Diercks, A. R., Asper, V. L., **Orphan, V. J.**, ... & Joye, S. B. (2014). The rise and fall of methanotrophy following a deepwater oil-well blowout. *Nature Geoscience*. 6:423-427.
- 70) Wilbanks, E.G, W. Jaekel, V. Salman, P.T. Humphrey, J. A. Eisen, M.T. Faccioli, D. H. Buckley, S.H. Zinder, G. K Druschel, D.A. Fike and **Orphan, V.J**, 2014. Microscale sulfur cycling in the phototrophic pink berry consortia of the Sippewissett Salt Marsh. *Environ. Microbiol.* DOI: 10.1111/1462-2920.12388

- 71) Sapir, A., Dillman A. R, Connon S. A, Grupe B. M, Ingels J., Mundo-Ocampo M., Levin L. A, Baldwin J.G, **Orphan, V.J**, Sternberg, P. W 2014. Microsporidia-nematode associations in methane seeps reveal basal fungal parasitism in the deep sea. *Frontiers in Microbiology* 5: 00043.
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