



AMERICAN
SOCIETY FOR
MICROBIOLOGY

Draft Genome Sequences of Two *Marinitoga camini* Isolates Producing Bacterioviruses

Coraline Mercier,^{a,b,c} Julien Lossouarn,^{a,b,c*} Thomas Haverkamp,^d Nadège Bienvenu,^{a,b,c} Anne Godfroy,^{a,b,c} Valérie Cueff-Gauchard,^{a,b,c} Claire Geslin,^{a,b,c} Camilla Nesbo^{d,e}

UBO, Laboratoire de Microbiologie des Environnements Extrêmes, UMR 6197, IUEM, Rue Dumont d'Urville, Plouzané, France^a; CNRS, Laboratoire de Microbiologie des Environnements Extrêmes, UMR 6197, IUEM, Rue Dumont d'Urville, Plouzané, France^b; Ifremer, Laboratoire de Microbiologie des Environnements Extrêmes, UMR 6197, CS10070, Plouzané, France^c; Centre for Ecological and Evolutionary Synthesis, University of Oslo, Oslo, Norway^d; Department of Biological Sciences, University of Alberta, Edmonton, Alberta, Canada^e

* Present address: Julien Lossouarn, Micalis Institute, INRA, AgroParisTech, Université Paris-Saclay, Jouy-en-Josas, France.

Here, we present the draft genome sequences of two thermophilic *Marinitoga* strain members of the *Thermotogales* order, *Marinitoga camini* DV1155 and *Marinitoga camini* DV1197. These strains were isolated from deep-sea hydrothermal vents of the Mid-Atlantic Ridge.

Received 16 September 2016 Accepted 21 September 2016 Published 10 November 2016

Citation Mercier C, Lossouarn J, Haverkamp T, Bienvenu N, Godfroy A, Cueff-Gauchard V, Geslin C, Nesbo C. 2016. Draft genome sequences of two *Marinitoga camini* isolates producing bacterioviruses. *Genome Announc* 4(6):e01261-16. doi:10.1128/genomeA.01261-16.

Copyright © 2016 Mercier et al. This is an open-access article distributed under the terms of the [Creative Commons Attribution 4.0 International license](#).

Address correspondence to Claire Geslin, claire.geslin@univ-brest.fr.

Bacteria from the *Marinitoga* genus are thermophilic, anaerobic, and organotrophic microorganisms isolated from various hot environments such as deep-sea hydrothermal vents or costal thermal springs. Among the five *Marinitoga* species described (1–5), only the *M. piezophila* KA3 genome has been sequenced (6). Here, we present the draft genome sequences of two novel *Marinitoga camini* isolates, DV1155 and DV1197, both containing proviral sequences.

The two strains were sampled during the DIVA 2 cruise in 1994 (7). *M. camini* DV1155 was isolated from a black smoker chimney at the Menez Gwen site. This hydrothermal field is located on the Mid-Atlantic Ridge at a depth of 840 to 870 m (8). *M. camini* DV1197 was isolated from a colonization module deployed at the Lucky strike hydrothermal vent field. This site is located at 1700 m of depth in the Mid-Atlantic Ridge (8). Strains DV1197 and DV1155 grow optimally at 60°C and 65°C, respectively, at atmospheric pressure in a modified Ravot medium (9) with elemental sulfur instead of cysteine.

Genomic DNA was extracted following the protocol of Geslin et al. (10). The purity and quantity of the DNA were measured using Nanodrop and Qubit instruments (Thermo, Fisher Scientific). Shotgun libraries were constructed using the Nextera XT kit and sequenced as one of ten pooled, barcoded libraries on a MiSeq (all from Illumina) using 500 cycles generating 2 × 250 bp paired-end reads. The genomes assembled *de novo* by CLC Genomics Workbench 7.0.4, using trimming default settings, automatic word size, a bubble size corresponding to the average length of the input reads, a minimum contig length of 1000 bp, and reads mapped back to the contigs.

For *M. camini* DV1155 this resulted in 56 contigs totaling 2,435,399 bp, with an N_{50} of 90,885 bp, longest contig size of 254.99 bp, and G+C content of 27.3%. No extrachromosomal DNA was observed but a proviral sequence of 50,700 pb was found

in the genome using Prophinder (11). For *M. camini* DV1197, we obtained 51 contigs totaling 2,274,557 bp with an N_{50} of 72,669, longest contig size of 188,990 bp, and a G+C content of 27.4%. No extrachromosomal DNA was observed but a proviral sequence of 53,437 bp was detected using the same methods than for *M. camini* DV1155.

Both draft genomes were annotated in the NCBI Prokaryotic Genome Automatic Annotation Pipeline (PGAAP [12]), which identified 2,315 genes and 2,256 coding sequences (CDS) for *M. camini* DV1155 and 2,221 genes and 2,157 CDS for *M. camini* DV1197.

Accession number(s). Both whole-genome shotgun projects have been deposited at DDBJ/EMBL/GenBank under the accession no. [AZAX00000000](#) and [AZAY00000000](#) for *M. camini* DV1155 and *M. camini* DV1197, respectively. The versions described in this paper are the first versions, AZAX01000000 and AZAY01000000.

ACKNOWLEDGMENTS

We thank Daniel Desbruyères, chief scientist of the French oceanographic cruise “DIVA 2” (1994), the captain and crew of the *Nadir*, the DSV *Nautilus* pilots, and support crew.

FUNDING INFORMATION

This work, including the efforts of Coraline Mercier, was funded by French Ministry of Higher Education. This work, including the efforts of Coraline Mercier, was funded by Brittany Region. This work, including the efforts of Camilla Lothe Nesbo, was funded by Norwegian Research Council (award 180444/V40). This work, including the efforts of Claire Geslin, was funded by Agence Nationale de la Recherche (ANR) (ANR-12-BSV3-OO23-01).

REFERENCES

- Wery N, Lesongeur F, Pignet P, Derennes V, Cambon-Bonavita MA, Godfroy A, Barbier G. 2001. *Marinitoga camini* gen. nov., sp. nov., a

- rod-shaped bacterium belonging to the order *Thermotogales*, isolated from a deep-sea hydrothermal vent. *Int J Syst Evol Microbiol* 51:495–504. <http://dx.doi.org/10.1099/00207713-51-2-495>.
2. Alain K, Marteinsson VT, Miroshnichenko ML, Bonch-Osmolovskaya EA, Prieur D, Birrien J-L. 2002. *Marinitoga piezophila* sp. nov., a rod-shaped, thermo-piezophilic bacterium isolated under high hydrostatic pressure from a deep-sea hydrothermal vent. *Int J Syst Evol Microbiol* 52:1331–1339. <http://dx.doi.org/10.1099/00207713-52-4-1331>.
 3. Nunoura T, Oida H, Miyazaki M, Suzuki Y, Takai K, Horikoshi K. 2007. *Marinitoga okinawensis* sp. nov., a novel thermophilic and anaerobic heterotroph isolated from a deep-sea hydrothermal field, Southern Okinawa trough. *Int J Syst Evol Microbiol* 57:467–471. <http://dx.doi.org/10.1099/ijss.0.64640-0>.
 4. Postec A, Le Breton C, Fardeau M-L, Lesongeur F, Pignet P, Querellou J, Ollivier B, Godfroy A. 2005. *Marinitoga hydrogenitolerans* sp. nov., a novel member of the order *Thermotogales* isolated from a black smoker chimney on the Mid-Atlantic Ridge. *Int J Syst Evol Microbiol* 55: 1217–1221. <http://dx.doi.org/10.1099/ijss.0.63550-0>.
 5. Postec A, Ciobanu M, Birrien JL, Bienvenu N, Prieur D, Le Romancer M. 2010. *Marinitoga litoralis* sp. nov., a thermophilic, heterotrophic bacterium isolated from a coastal thermal spring on Ile Saint-Paul, southern Indian Ocean. *Int J Syst Evol Microbiol* 60:1778–1782. <http://dx.doi.org/10.1099/ijss.0.017574-0>.
 6. Lucas S, Han J, Lapidus A, Cheng J-F, Goodwin LA, Pitluck S, Peters L, Mikhailova N, Teshima H, Detter JC, Han C, Tapia R, Land M, Hauser L, Kyrpides NC, Ivanova N, Pagani I, Vannier P, Oger P, Bartlett DH, Noll KM, Woyke T, Jebbar M. 2012. Complete genome sequence of the thermophilic, piezophilic, heterotrophic bacterium *Marinitoga piezophila* KA3. *J Bacteriol* 194:5974–5975. <http://dx.doi.org/10.1128/JB.01430-12>.
 7. Desbruyeres D, Alayse A-M, Antoine E, Barbier G, Barriga F, Bischoff M, Briand P, Brulport J-P, Comtet T, Cornec L, Crassous P, Dando PR, Marie-claire F, Felbeck H, Lallier FH, Fiala-Medioni A, Gonçalves JM, Ménard F, Kerdoncuff JP, Saldanha L, Pierre-marie S. 1994. New information on the ecology of deep-sea vent communities in the Azores triple junction area: preliminary results of the Diva 2 cruise. *InterRidge News* 3:18–19.
 8. Colaço A, Desbruyères D, Comtet T, Alayse A. 1998. Ecology of the Menez Gwen hydrothermal vent field (Mid-Atlantic Ridge/Azores triple junction). *Cah Biol Mar* 39:237–240.
 9. Lossouarn J, Nesbø CL, Mercier C, Zhaxybayeva O, Johnson MS, Charchuk R, Farasin J, Bienvenu N, Baudoux A-C, Michoud G, Jebbar M, Geslin C. 2015. “Ménage à trois”: a selfish genetic element uses a virus to propagate within Thermotogales. *Environ Microbiol* 17:3278–3288. <http://dx.doi.org/10.1111/1462-2920.12783>.
 10. Geslin C, Le Romancer M, Erauso G, Gaillard M, Perrot G, Prieur D. 2003. PAV1, the first virus-like particle isolated from a hyperthermophilic euryarchaeote, “*Pyrococcus abyssi*.” *J Bacteriol* 185:3888–3894. <http://dx.doi.org/10.1128/JB.185.13.3888-3894.2003>.
 11. Lima-Mendez G, Van Helden J, Toussaint A, Leplae R. 2008. Prophinder: A computational tool for prophage prediction in prokaryotic genomes. *Bioinformatics* 24:863–865. <http://dx.doi.org/10.1093/bioinformatics/btn043>.
 12. Angiuoli SV, Gussman A, Klimke W, Cochrane G, Field D, Garrity GM, Kodira CD, Kyrpides N, Madupu R, Markowitz V, Tatusova T, Thomson N, White O. 2008. Toward an online repository of standard operating procedures (SOPs) for (meta) genomic annotation. *Oomics* 12:137–141. <http://dx.doi.org/10.1089/omi.2008.0017>.