

Short presentation

Exploring Mars as a member of the ongoing NASA Mars missions: Mars Science Laboratory (Curiosity rover) and Mars 2020 (Perseverance rover).

Jens Frydenvang

Assistant professor

Globe Institute, University of Copenhagen

Postal address:

Øster Voldgade 5-7, 1350 København K

Email: jfrydenvang@ign.ku.dk

Mobile: +45 20 65 50 63

Phone: +45 35 33 39 23

Web: <http://ign.ku.dk/>

Research outputs

Radiation-induced alteration of apatite on the surface of Mars: first in situ observations with SuperCam Raman onboard Perseverance

Clavé, E., Beyssac, O., Bernard, S., Royer, C., Lopez-Reyes, G., Schröder, S., Rammelkamp, K., Forni, O., Fau, A., Cousin, A., Manrique, J. A., Ollila, A., Madariaga, J. M., Aramendia, J., Sharma, S. K., Fornaro, T., Maurice, S., Wiens, R. C., Acosta-Maeda, T., Agard, C. & 144 others, Alberquilla, F., Alvarez Llamas, C., Anderson, R., Applin, D., Aramendia, J., Arana, G., Beal, R., Beck, P., Bedford, C., Benzerara, K., Bernard, S., Bernardi, P., Bertrand, T., Beyssac, O., Bloch, T., Bonnet, J. Y., Bousquet, B., Boustelitane, A., Bouyssou Mann, M., Brand, M., Cais, P., Caravaca, G., Castro Ortiz De Pinedo, K., Cazalla, C., Charpentier, A., Chide, B., Clavé, E., Clegg, S., Cloutis, E., Coloma, L., Comellas, J., Connell, S., Cousin, A., DeFlores, L., Dehouck, E., Delapp, D., Delgado Perez, T., Deron, R., Donny, C., Doressoundiram, A., Dromart, G., Essunfeld, A., Fabre, C., Fau, A., Fischer, W., Follic, H., Forni, O., Fouchet, T., Francis, R., Frydenvang, Jens, Gabriel, T., Gallegos, Z., García-Florentino, C., Gasda, P., Gasnault, O., Gibbons, E., Gillier, M., Gomez, L., Gonzalez, S., Grotzinger, J., Huidobro, J., Jacob, X., Johnson, J., Kalucha, H., Kelly, E., Knutsen, E., Lacombe, G., Lamarque, F., Lanza, N., Larmat, C., Laserna, J., Lasue, J., Le Deit, L., Le Mouelic, S., Legett, C., Leveille, R., Lewin, E., Little, C., Loche, M., Lopez Reyes, G., Lorenz, R., Lorigny, E., Madariaga, J. M., Madsen, Morten Bo, Mandon, L., Manelski, H., Mangold, N., Martinez, J. M., Martin, N., Martinez Frias, J., Maurice, S., Mcconnochie, T., McLennan, S., Melikechi, N., Meslin, P. Y., Meunier, F., Mimoun, D., Montagnac, G., Montmessin, F., Moros, J., Mousset, V., Murdoch, N., Nelson, T., Newell, R., Nicolas, C., Newsom, H., O'Shea, C., Ollila, A., Pantalacci, P., Parmentier, J., Peret, L., Perrachon, P., Pilleri, P., Pilorget, C., Pinet, P., Poblacion, I., Poulet, F., Quantin Nataf, C., Rapin, W., Reyes, I., Rigaud, L., Robinson, S., Rochas, L., Root, M., Ropert, E., Rouverand, L., Royer, C., Rull Perez, F., Said, D., Sans-Jofre, P., Schroeder, S., Seel, F., Sharma, S., Sheridan, A., Sobron Sanchez, P., Stcherbinine, A., Stott, A., Toplis, M., Turenne, N., Veneranda, M., Venhaus, D., Wiens, R., Wolf, U. & Zastrow, A., Dec 2024, In: *Scientific Reports*. 14, 1, 11284.

Manganese-Rich Sandstones as an Indicator of Ancient Oxidic Lake Water Conditions in Gale Crater, Mars

Gasda, P. J., Lanza, N. L., Meslin, P. Y., Lamm, S. N., Cousin, A., Anderson, R., Forni, O., Swanner, E., L'Haridon, J., Frydenvang, J., Thomas, N., Gwizd, S., Stein, N., Fischer, W. W., Hurowitz, J., Sumner, D., Rivera-Hernández, F., Crossey, L., Ollila, A., Essunfeld, A. & 8 others, Newsom, H. E., Clark, B., Wiens, R. C., Gasnault, O., Clegg, S. M., Maurice, S., Delapp, D. & Reyes-Newell, A., May 2024, In: *Journal of Geophysical Research: Planets*. 129, 5, e2023JE007923.

Sedimentology and Stratigraphy of the Shenandoah Formation, Western Fan, Jezero Crater, Mars

Stack, K. M., Ives, L. R. W., Gupta, S., Lamb, M. P., Tebolt, M., Caravaca, G., Grotzinger, J. P., Russell, P., Shuster, D. L., Williams, A. J., Amundsen, H., Alwmark, S., Annex, A. M., Barnes, R., Bell, J., Beyssac, O., Bosak, T., Crumpler, L. S., Dehouck, E., Gwizd, S. J. & 23 others, Hickman-Lewis, K., Horgan, B. H. N., Hurowitz, J., Kalucha, H., Kanine, O., Lesh, C., Maki, J., Mangold, N., Randazzo, N., Seeger, C., Williams, R. M. E., Brown, A., Cardarelli, E., Dypvik, H., Flannery, D., Frydenvang, Jens, Hamran, S., Núñez, J. I., Paige, D., Simon, J. I., Tice, M., Tate, C. & Wiens, R. C., 2024, In: *Journal of Geophysical Research: Planets*. 129, 2, 42 p., e2023JE008187.

Askival: An altered feldspathic cumulate sample in Gale crater

Bowden, D. L., Bridges, J. C., Cousin, A., Rapin, W., Semprich, J., Gasnault, O., Forni, O., Gasda, P., Das, D., Payré, V., Sautter, V., Bedford, C. C., Wiens, R. C., Pinet, P. & Frydenvang, Jens, 2023, In: *Meteoritics and Planetary Science*. 58, 1, p. 41-62 22 p.

Compositional Variations in Sedimentary Deposits in Gale Crater as Observed by ChemCam Passive and Active Spectra

Manelski, H. T., Sheppard, R. Y., Fraeman, A. A., Wiens, R. C., Johnson, J. R., Rampe, E. B., Frydenvang, Jens, Lanza, N. L. & Gasnault, O., 2023, In: *Journal of Geophysical Research: Planets*. 128, 3, 19 p., e2022JE007706.

Detection of Copper by the ChemCam Instrument Along Curiosity's Traverse in Gale Crater, Mars: Elevated Abundances in Glen Torridon

Goetz, W., Dehouck, E., Gasda, P. J., Johnson, J. R., Meslin, P., Lanza, N. L., Wiens, R. C., Rapin, W., Frydenvang, Jens, Payré, V. & Gasnault, O., 2023, In: *Journal of Geophysical Research: Planets*. 128, 3, 23 p., e2021JE007101.

Aqueously altered igneous rocks sampled on the floor of Jezero crater, Mars

Farley, K. A., Stack, K. M., Shuster, D. L., Horgan, B. H. N., Hurowitz, J. A., Tarnas, J. D., Simon, J. I., Sun, V. Z., Scheller, E. L., Moore, K. R., McLennan, S. M., Vasconcelos, P. M., Wiens, R. C., Treiman, A. H., Mayhew, L. E., Beyssac, O., Kizovski, T. V., Tosca, N. J., Williford, K. H., Crumpler, L. S. & 94 others, Beegle, L. W., Bell, J. F., Ehlmann, B. L., Liu, Y., Maki, J. N., Schmidt, M. E., Allwood, A. C., Amundsen, H. E. F., Bhartia, R., Bosak, T., Brown, A. J., Clark, B. C., Cousin, A., Forni, O., Gabriel, T. S. J., Goreva, Y., Gupta, S., Hamran, S., Herd, C. D. K., Hickman-Lewis, K., Johnson, J. R., Kah, L. C., Kelemen, P. B., Kinch, Kjartan Münster, Mandon, L., Mangold, N., Quantin-Nataf, C., Rice, M. S., Russell, P. S., Sharma, S., Siljeström, S., Steele, A., Sullivan, R., Wadhwa, M., Weiss, B. P., Williams, A. J., Wogsland, B. V., Willis, P. A., Acosta-Maeda, T. A., Beck, P., Benzerara, K., Bernard, S., Burton, A. S., Cardarelli, E. L., Chide, B., Clavé, E., Cloutis, E. A., Cohen, B. A., Czaja, A. D., Debaille, V., Dehouck, E., Fairén, A. G., Flannery, D. T., Fleron, S. Z., Fouchet, T., Frydenvang, Jens, Garczynski, B. J., Gibbons, E. F., Hausrath, E. M., Hayes, A. G., Henneke, J., Jørgensen, J. L., Kelly, E. M., Lasue, J., Le Mouélic, S., Madariaga, J. M., Maurice, S., Merusi, M., Meslin, P., Milkovich, S. M., Million, C. C., Moeller, R. C., Nuñez, J. I., Ollila, A. M., Paar, G., Paige, D. A., Pedersen, D. A. K., Pilleri, P., Pilorget, C., Pinet, P. C., Rice, J. W., Royer, C., Sautter, V., Schulte, M., Sephton, M. A., Sharma, S. K., Sholes, S. F., Spanovich, N., Clair, M. S., Tate, C. D., Uckert, K., VanBommel, S. J., Yanchilina, A. G. & Zorzano, M., 30 Sep 2022, In: *Science*. 377, 6614, 12 p., eabo2196.

An Insight Into Ancient Aeolian Processes and Post-Noachian Aqueous Alteration in Gale Crater, Mars, Using ChemCam Geochemical Data From the Greenheugh Capping Unit

Bedford, C. C., Banham, S. G., Bridges, J. C., Forni, O., Cousin, A., Bowden, D., Turner, S. M. R., Wiens, R. C., Gasda, P. J., Frydenvang, Jens, Gasnault, O., Rammelkamp, K., Rivera-Hernandez, F., Rampe, E. B., Smith, R., Achilles, C., Dehouck, E., Bryk, A. B., Schwenzer, S. P. & Newsom, H., 2022, In: *Journal of Geophysical Research - Planets*. 127, 9, 37 p., e2021JE007100.

Bedrock Geochemistry and Alteration History of the Clay-Bearing Glen Torridon Region of Gale Crater, Mars

Dehouck, E., Cousin, A., Mangold, N., Frydenvang, J., Gasnault, O., Forni, O., Rapin, W., Gasda, P. J., Caravaca, G., David, G., Bedford, C. C., Lasue, J., Meslin, P.-Y., Rammelkamp, K., Desjardins, M., Le Mouélic, S., Thorpe, M. T., Fox, V. K., Bennett, K. A., Bryk, A. B. & 3 others, Lanza, N. L., Maurice, S. & Wiens, R. C., 2022, In: *Journal of Geophysical Research: Planets*. 127, 12, 29 p., e2021JE007103.

Burial and Exhumation of Sedimentary Rocks Revealed by the Base Stimson Erosional Unconformity, Gale Crater, Mars

Watkins, J. A., Grotzinger, J. P., Stein, N. T., Banham, S. G., Gupta, S., Rubin, D. M., Morgan, K. S., Edgett, K. S., Frydenvang, Jens, Siebach, K. L., Lamb, M. P., Sumner, D. Y. & Lewis, K. W., 2022, In: *Journal of Geophysical Research - Planets*. 127, 7, 15 p., e2022JE007293.

Compositionally and density stratified igneous terrain in Jezero crater, Mars

Wiens, R. C., Udry, A., Beyssac, O., Quantin-Nataf, C., Mangold, N., Cousin, A., Mandon, L., Bosak, T., Forni, O., McLennan, S. M., Sautter, V., Brown, A., Benzerara, K., Johnson, J. R., Mayhew, L., Maurice, S., Anderson, R. B., Clegg, S. M., Crumpler, L., Gabriel, T. S. J. & 73 others, Gasda, P., Hall, J., Horgan, B. H. N., Kah, L., Leggett, C., Madariaga, J. M., Meslin, P., Ollila, A. M., Poulet, F., Royer, C., Sharma, S. K., Siljeström, S., Simon, J. I., Acosta-Maeda, T. E., Alvarez-Llamas, C., Angel, S. M., Arana, G., Beck, P., Bernard, S., Bertrand, T., Bousquet, B., Castro, K., Chide, B., Clavé, E., Cloutis, E., Connell, S., Dehouck, E., Dromart, G., Fischer, W., Fouchet, T., Francis, R., Frydenvang, Jens, Gasnault, O., Gibbons, E., Gupta, S., Hausrath, E. M., Jacob, X., Kalucha, H., Kelly, E., Knutsen, E., Lanza, N., Laserna, J., Lasue, J., Le Mouélic, S., Leveille, R., Lopez-Reyes, G., Lorenz, R., Manrique, J. A., Martinez-Frias, J., McConnochie, T., Melikechi, N., Mimoun, D., Montmessin, F., Moros, J., Murdoch, N., Pilleri, P., Pilorget, C., Pinet, P., Rapin, W., Rull, F., Schröder, S., Shuster, D. L., Smith, R. J., Stott, A. E., Tarnas, J., Turenne, N., Veneranda, M., Vogt, D. S., Weiss, B. P., Willis, P., Stack, K. M., Williford, K. H. & Farley, K. A., 2022, In: *Science Advances*. 8, 34, 16 p., eabo3399.

In situ recording of Mars soundscape

Farley, K., Williford, K. & the SuperCam team, T. S. T., 2022, In: *Nature*. 605, 7911, p. 653-658 6 p.

On an Extensive Late Hydrologic Event in Gale Crater as Indicated by Water-Rich Fracture Halos

Gabriel, T. S. J., Hardgrove, C., Achilles, C. N., Rampe, E. B., Rapin, W. N., Nowicki, S., Czarnecki, S., Thompson, L., Nikiforov, S., Litvak, M., Mitrofanov, I., Lisov, D., Frydenvang, Jens, Yen, A., Wiens, R. C., Treiman, A. & McAdam, A.,

Overview of the Morphology and Chemistry of Diagenetic Features in the Clay-Rich Glen Torridon Unit of Gale Crater, Mars

Gasda, P. J., Comellas, J., Essunfeld, A., Das, D., Bryk, A. B., Dehouck, E., Schwenzer, S. P., Crossey, L., Herkenhoff, K., Johnson, J. R., Newsom, H., Lanza, N. L., Rapin, W., Goetz, W., Meslin, P.-Y., Bridges, J. C., Anderson, R., David, G., Turner, S. M. R., Thorpe, M. T. & 16 others, Kah, L., Frydenvang, Jens, Kronyak, R., Caravaca, G., Ollila, A., Le Mouélic, S., Nellessen, M., Hoffman, M., Fey, D., Cousin, A., Wiens, R. C., Clegg, S. M., Maurice, S., Gasnault, O., Delapp, D. & Reyes-Newell, A., 2022, In: Journal of Geophysical Research: Planets. 127, 12, 42 p., e2021JE007097.

Post-landing major element quantification using SuperCam laser induced breakdown spectroscopy

Anderson, R. B., Forni, O., Cousin, A., Wiens, R. C., Clegg, S. M., Frydenvang, J., Gabriel, T. S. J., Ollila, A., Schröder, S., Beyssac, O., Gibbons, E., Vogt, D. S., Clavé, E., Manrique, J.-A., Legett, C., Pilleri, P., Newell, R. T., Sarrao, J., Maurice, S., Arana, G. & 42 others, Benzerara, K., Bernardi, P., Bernard, S., Bousquet, B., Brown, A. J., Alvarez-Llamas, C., Chide, B., Cloutis, E., Comellas, J., Connell, S., Dehouck, E., Delapp, D. M., Essunfeld, A., Fabre, C., Fouchet, T., Garcia-Florentino, C., García-Gómez, L., Gasda, P., Gasnault, O., Hausrath, E. M., Lanza, N. L., Laserna, J., Lasue, J., Lopez, G., Madariaga, J. M., Mandon, L., Mangold, N., Meslin, P., Nelson, A. E., Newsom, H., Reyes-Newell, A. L., Robinson, S., Rull, F., Sharma, S., Simon, J. I., Sobron, P., Fernandez, I. T., Udry, A., Venhaus, D., McLennan, S. M., Morris, R. V. & Ehlmann, B., 2022, In: Spectrochimica Acta - Part B Atomic Spectroscopy. 188, 33 p., 106347.

Brine-driven destruction of clay minerals in Gale crater, Mars

Bristow, T. F., Grotzinger, J. P., Rampe, E. B., Cuadros, J., Chipera, S. J., Downs, G. W., Fedo, C. M., Frydenvang, J., McAdam, A. C., Morris, R. V., Achilles, C. N., Blake, D. F., Castle, N., Craig, P., Marais, D. J. D., Downs, R. T., Hazen, R. M., Ming, D. W., Morrison, S. M., Thorpe, M. T. & 13 others, Treiman, A. H., Tu, V., Vaniman, D. T., Yen, A. S., Gellert, R., Mahaffy, P. R., Wiens, R. C., Bryk, A. B., Bennett, K. A., Fox, V. K., Milliken, R. E., Fraeman, A. A. & Vasavada, A. R., 2021, In: Science. 373, 6551, p. 198-204

Improving ChemCam LIBS long-distance elemental compositions using empirical abundance trends

Wiens, R. C., Blazon-Brown, A. J., Melikechi, N., Frydenvang, Jens, Dehouck, E., Clegg, S. M., Delapp, D., Anderson, R. B., Cousin, A. & Maurice, S., 2021, In: Spectrochimica Acta - Part B Atomic Spectroscopy. 182, 18 p., 106247.

Quantification of manganese for ChemCam Mars and laboratory spectra using a multivariate model

Gasda, P. J., Anderson, R. B., Cousin, A., Forni, O., Clegg, S. M., Ollila, A., Lanza, N., Frydenvang, Jens, Lamm, S., Wiens, R. C., Maurice, S., Gasnault, O., Beal, R., Reyes-Newell, A. & Delapp, D., 2021, In: Spectrochimica Acta - Part B Atomic Spectroscopy. 181, 13 p., 106223.

The SuperCam Instrument Suite on the Mars 2020 Rover: Science Objectives and Mast-Unit Description

Maurice, S., Wiens, R. C., Bernardi, P., Caïs, P., Robinson, S., Nelson, T., Gasnault, O., Reess, J. M., Deleuze, M., Rull, F., Manrique, J. A., Abbaki, S., Anderson, R. B., André, Y., Angel, S. M., Arana, G., Battault, T., Beck, P., Benzerara, K., Bernard, S. & 147 others, Berthias, J. P., Beyssac, O., Bonafous, M., Bousquet, B., Boutillier, M., Cadu, A., Castro, K., Chapron, F., Chide, B., Clark, K., Clavé, E., Clegg, S., Cloutis, E., Collin, C., Cordoba, E. C., Cousin, A., Dameury, J. C., D'Anna, W., Daydou, Y., Debus, A., Deflores, L., Dehouck, E., Delapp, D., De Los Santos, G., Donny, C., Doressoundiram, A., Dromart, G., Dubois, B., Dufour, A., Dupieux, M., Egan, M., Ervin, J., Fabre, C., Fau, A., Fischer, W., Forni, O., Fouchet, T., Frydenvang, Jens, Gauffre, S., Gauthier, M., Gharakanian, V., Gilard, O., Gontijo, I., Gonzalez, R., Granena, D., Grotzinger, J., Hassen-Khodja, R., Heim, M., Hello, Y., Hervet, G., Humeau, O., Jacob, X., Jacquino, S., Johnson, J. R., Kouach, D., Lacombe, G., Lanza, N., Lapauw, L., Laserna, J., Lasue, J., Le Deit, L., Le Mouélic, S., Le Comte, E., Lee, Q. M., Legett, C., Leveille, R., Lewin, E., Leyrat, C., Lopez-Reyes, G., Lorenz, R., Lucero, B., Madariaga, J. M., Madsen, S., Madsen, Morten Bo, Mangold, N., Manni, F., Mariscal, J. F., Martinez-Frias, J., Mathieu, K., Mathon, R., McCabe, K. P., McConnochie, T., McLennan, S. M., Mekki, J., Melikechi, N., Meslin, P., Micheau, Y., Michel, Y., Michel, J. M., Mimoun, D., Misra, A., Montagnac, G., Montaron, C., Montmessin, F., Moros, J., Mousset, V., Morizet, Y., Murdoch, N., Newell, R. T., Newsom, H., Nguyen Tuong, N., Ollila, A. M., Ortner, G., Oudda, L., Pares, L., Parisot, J., Parot, Y., Pérez, R., Pheav, D., Picot, L., Pilleri, P., Pilorget, C., Pinet, P., Pont, G., Poulet, F., Quantin-Nataf, C., Quartier, B., Rambaud, D., Rapin, W., Romano, P., Roucayrol, L., Royer, C., Ruellan, M., Sandoval, B. F., Sautter, V., Schoppers, M. J., Schröder, S., Seran, H. C., Sharma, S. K., Sobron, P., Sodki, M., Sournac, A., Sridhar, V., Standarovsky, D., Storms, S., Striebig, N., Tatat, M., Toplis, M., Torre-Fdez, I., Toulemont, N., Velasco, C., Veneranda, M., Venhaus, D., Virmondois, C., Viso, M., Willis, P. & Wong, K. W., 2021, In: Space Science Reviews. 217, 3, 108 p., 47.

The SuperCam Instrument Suite on the NASA Mars 2020 Rover: Body Unit and Combined System Tests

Wiens, R. C., Maurice, S., Robinson, S. H., Nelson, A. E., Caïs, P., Bernardi, P., Newell, R. T., Clegg, S., Sharma, S. K., Storms, S., Deming, J., Beckman, D., Ollila, A. M., Gasnault, O., Anderson, R. B., André, Y., Michael Angel, S., Arana, G., Auden, E., Beck, P. & 112 others, Becker, J., Benzerara, K., Bernard, S., Beyssac, O., Borges, L., Bousquet, B., Boyd, K.,

Caffrey, M., Carlson, J., Castro, K., Celis, J., Chide, B., Clark, K., Cloutis, E., Cordoba, E. C., Cousin, A., Dale, M., Deflores, L., Delapp, D., Deleuze, M., Dirmyer, M., Donny, C., Dromart, G., George Duran, M., Egan, M., Ervin, J., Fabre, C., Fau, A., Fischer, W., Forni, O., Fouchet, T., Fresquez, R., Frydenvang, Jens, Gasway, D., Gontijo, I., Grotzinger, J., Jacob, X., Jacquiod, S., Johnson, J. R., Klisiewicz, R. A., Lake, J., Lanza, N., Laserna, J., Lasue, J., Le Mouélic, S., Legett, C., Leveille, R., Lewin, E., Lopez-Reyes, G., Lorenz, R., Lorigny, E., Love, S. P., Lucero, B., Madariaga, J. M., Madsen, Morten Bo, Madsen, S., Mangold, N., Manrique, J. A., Martinez, J. P., Martinez-Frias, J., McCabe, K. P., McConnochie, T. H., McGlown, J. M., McLennan, S. M., Melikechi, N., Meslin, P., Michel, J. M., Mimoun, D., Misra, A., Montagnac, G., Montmessin, F., Mousset, V., Murdoch, N., Newsom, H., Ott, L. A., Ousnamer, Z. R., Pares, L., Parot, Y., Pawluczyk, R., Glen Peterson, C., Pilleri, P., Pinet, P., Pont, G., Poulet, F., Provost, C., Quertier, B., Quinn, H., Rapin, W., Reess, J. M., Regan, A. H., Reyes-Newell, A. L., Romano, P. J., Royer, C., Rull, F., Sandoval, B., Sarrao, J. H., Sautter, V., Schoppers, M. J., Schröder, S., Seitz, D., Shepherd, T., Sobron, P., Dubois, B., Sridhar, V., Toplis, M. J., Torre-Fdez, I., Trettel, I. A., Underwood, M., Valdez, A., Valdez, J., Venhaus, D. & Willis, P., 2021, In: Space Science Reviews. 217, 87 p., 4.

Diagenesis of Vera Rubin Ridge, Gale Crater, Mars, From Mastcam Multispectral Images

Horgan, B. H. N., Johnson, J. R., Fraeman, A. A., Rice, M. S., Seeger, C., Bell, J. F., Bennett, K. A., Cloutis, E. A., Edgar, L. A., Frydenvang, Jens, Grotzinger, J. P., L'Haridon, J., Jacob, S. R., Mangold, N., Rampe, E. B., Rivera-Hernandez, F., Sun, V. Z., Thompson, L. M. & Wellington, D., Nov 2020, In: Journal of Geophysical Research: Planets. 125, 11, 33 p., e2019JE006322.

Identification and Description of a Silicic Volcaniclastic Layer in Gale Crater, Mars, Using Active Neutron Interrogation

Czarnecki, S., Hardgrove, C., Gasda, P. J., Gabriel, T. S. J., Starr, M., Rice, M. S., Frydenvang, Jens, Wiens, R. C., Rapin, W., Nikiforov, S., Lisov, D., Litvak, M., Calef, F., Gengl, H., Newsom, H. E., Thompson, L. & Nowicki, S., 1 Mar 2020, In: Journal of Geophysical Research: Planets. 125, 3, 20 p., e2019JE006180.

Boron and Lithium in Calcium Sulfate Veins: Tracking Precipitation of Diagenetic Materials in Vera Rubin Ridge, Gale Crater

Das, D., Gasda, P. J., Wiens, R. C., Berlo, K., Leveille, R. J., Frydenvang, Jens, Mangold, N., Kronyak, R. E., Schwenzer, S. P., Forni, O., Cousin, A., Maurice, S. & Gasnault, O., 2020, In: Journal of Geophysical Research: Planets. 125, 8, 21 p., e2019JE006301.

Evidence for a Diagenetic Origin of Vera Rubin Ridge, Gale Crater, Mars: Summary and Synthesis of Curiosity's Exploration Campaign

Fraeman, A. A., Edgar, L. A., Rampe, E. B., Thompson, L. M., Frydenvang, J., Fedo, C. M., Catalano, J. G., Dietrich, W. E., Gabriel, T. S. J., Vasavada, A. R., Grotzinger, J. P., L'Haridon, J., Mangold, N., Sun, V. Z., House, C. H., Bryk, A. B., Hardgrove, C., Czarnecki, S., Stack, K. M., Morris, R. V. & 23 others, Arvidson, R. E., Banham, S. G., Bennett, K. A., Bridges, J. C., Edwards, C. S., Fischer, W. W., Fox, V. K., Gupta, S., Horgan, B. H. N., Jacob, S. R., Johnson, J. R., Johnson, S. S., Rubin, D. M., Salvatore, M. R., Schwenzer, S. P., Siebach, K. L., Stein, N. T., Turner, S. M. R., Wellington, D. F., Wiens, R. C., Williams, A. J., David, G. & Wong, G. M., 2020, In: Journal of Geophysical Research: Planets. 125, 12, 34 p., e2020JE006527.

Geochemical variation in the Stimson formation of Gale crater: Provenance, mineral sorting, and a comparison with modern Martian dunes

Bedford, C. C., Schwenzer, S. P., Bridges, J. C., Banham, S., Wiens, R. C., Gasnault, O., Rampe, E. B., Frydenvang, Jens & Gasda, P. J., 2020, In: Icarus. 341, 22 p., 113622.

Hydrogen Variability in the Murray Formation, Gale Crater, Mars

Thomas, N. H., Ehlmann, B. L., Rapin, W., Rivera-hernández, F., Stein, N. T., Frydenvang, Jens, Gabriel, T., Meslin, P. -, Maurice, S. & Wiens, R. C., 2020, In: Journal of Geophysical Research: Planets. 125, 9, p. 1-13

Iron Mobility During Diagenesis at Vera Rubin Ridge, Gale Crater, Mars

L'Haridon, J., Mangold, N., Fraeman, A. A., Johnson, J. R., Cousin, A., Rapin, W., David, G., Dehouck, E., Sun, V., Frydenvang, J., Gasnault, O., Gasda, P., Lanza, N., Forni, O., Meslin, P. Y., Schwenzer, S. P., Bridges, J., Horgan, B., House, C. H., Salvatore, M. & 2 others, Maurice, S. & Wiens, R. C., 2020, In: Journal of Geophysical Research: Planets. 125, 11, 24 p., e2019JE006299.

Origin and composition of three heterolithic boulder- and cobble-bearing deposits overlying the Murray and Stimson formations, Gale Crater, Mars

Wiens, R. C., Edgett, K. S., Stack, K. M., Dietrich, W. E., Bryk, A. B., Mangold, N., Bedford, C., Gasda, P., Fairen, A., Thompson, L., Johnson, J., Gasnault, O., Clegg, S., Cousin, A., Forni, O., Frydenvang, J., Lanza, N., Maurice, S.,

Newsom, H., Ollila, A. & 3 others, Payré, V., Rivera-Hernandez, F. & Vasavada, A., 2020, In: *Icarus*. 350, 38 p., 113897.

The Chemostratigraphy of the Murray Formation and Role of Diagenesis at Vera Rubin Ridge in Gale Crater, Mars, as Observed by the ChemCam Instrument

Frydenvang, J., Mangold, N., Wiens, R. C., Fraeman, A. A., Edgar, L. A., Fedo, C. M., L'Haridon, J., Bedford, C. C., Gupta, S., Grotzinger, J. P., Bridges, J. C., Clark, B. C., Rampe, E. B., Gasnault, O., Maurice, S., Gasda, P. J., Lanza, N. L., Ollila, A. M., Meslin, P. Y., Payré, V. & 3 others, Calef, F., Salvatore, M. & House, C. H., 2020, In: *Journal of Geophysical Research: Planets*. 125, 9, p. 1-21 e2019JE006320.

METHOD AND DEVICE FOR DETERMINING A NUTRITIONAL STATE OF A PLANT

Carstensen, A., Frydenvang, Jens, van Maarschalkerweerd, M. & Husted, Søren, 25 Sep 2019, IPC No. G01N 21/64 (2006.01), G01N 21/84 (2006.01), Patent No. PCT/EP2013/069899, 25 Sep 2013, Priority date 25 Sep 2013

Chemical alteration of fine-grained sedimentary rocks at Gale crater

Mangold, N., Dehouck, E., Fedo, C., Forni, O., Achilles, C., Bristow, T., Downs, R. T., Frydenvang, Jens, Gasnault, O., L'Haridon, J., Le Deit, L., Maurice, S., McLennan, S. M., Meslin, P., Morrison, S., Newsom, H. E., Rampe, E., Rapin, W., Rivera-Hernandez, F. & Salvatore, M., 15 Mar 2019, In: *Icarus*. 321, p. 619-631 13 p.

Chlorophyll a fluorescence analysis can detect phosphorus deficiency under field conditions and is an effective tool to prevent grain yield reductions in spring barley (*Hordeum vulgare* L.)

Carstensen, A., Szameitat, Augusta Egelund, Frydenvang, Jens & Husted, Søren, 15 Jan 2019, In: *Plant and Soil*. 434, 1-2, p. 79-91 13 p.

Alteration trends and geochemical source region characteristics preserved in the fluviolacustrine sedimentary record of Gale crater, Mars

Bedford, C. C., Bridges, J. C., Schwenzer, S. P., Wiens, R. C., Rampe, E. B., Frydenvang, Jens & Gasda, P. J., 2019, In: *Geochimica et Cosmochimica Acta*. 246, p. 234-266 33 p.

In Situ Analysis of Opal in Gale Crater, Mars

Rapin, W., Chauviré, B., Gabriel, T. S. J., Mcadam, A. C., Ehlmann, B. L., Hardgrove, C., Meslin, P., Rondeau, B., Dehouck, E., Franz, H. B., Mangold, N., Chipera, S. J., Wiens, R. C., Frydenvang, Jens & Schröder, S., Aug 2018, In: *Journal of Geophysical Research: Planets*. 123, p. 1955-1972

Incorporating AEGIS autonomous science into mars science laboratory rover mission operations

Francis, R., Estlin, T., Doran, G., Gaines, D., Johnstone, S., Montañó, S., Peret, L., Mousset, V., Gasnault, O., Frydenvang, Jens, Wiens, R. C., Schaffer, S., Pavri, B., Verma, V., Chattopadhyay, D., Bornstein, B., Mittal, N. & Deflores, L., 1 Jan 2018, *15th International Conference on Space Operations, 2018*. [publishername] American Institute of Aeronautics and Astronautics Inc, AIAA, AIAA 2018-2576. (15th International Conference on Space Operations, 2018).

Desiccation cracks provide evidence of lake drying on Mars, Sutton Island member, Murray formation, Gale Crater

Stein, N., Grotzinger, J. P., Schieber, J., Mangold, N., Hallet, B., Newsom, H. E., Stack, K. M., Berger, J. A., Thompson, L., Siebach, K. L., Cousin, A., Le Mouélic, S., Minitti, M., Sumner, D. Y., Fedo, C., House, C. H., Gupta, S., Vasavada, A. R., Gellert, R., Wiens, R. C. & 5 others, Frydenvang, Jens, Forni, O., Meslin, P., Payré, V. & Dehouck, E., 2018, In: *Geology*. 46, 6, p. 515-518 4 p.

Roughness effects on the hydrogen signal in laser-induced breakdown spectroscopy

Rapin, W., Bousquet, B., Lasue, J., Meslin, P. Y., Lacour, J. L., Fabre, C., Wiens, R. C., Frydenvang, Jens, Dehouck, E., Maurice, S., Gasnault, O., Forni, O. & Cousin, A., 1 Nov 2017, In: *Spectrochimica Acta Part B: Atomic Spectroscopy*. 137, p. 13-22 10 p.

Diagenetic silica enrichment and late-stage groundwater activity in Gale crater, Mars

Frydenvang, J., Gasda, P. J., Hurowitz, J. A., Grotzinger, J. P., Wiens, R. C., Newsom, H. E., Edgett, K. S., Watkins, J., Bridges, J. C., Maurice, S., Fisk, M. R., Johnson, J. R., Rapin, W., Stein, N. T., Clegg, S. M., Schwenzer, S. P., Bedford, C. C., Edwards, P., Mangold, N., Cousin, A. & 22 others, Anderson, R. B., Payre, V., Vaniman, D., Blake, D. F., Lanza, N. L., Gupta, S., Van Beek, J., Sautter, V., Meslin, P. -, Rice, M., Milliken, R., Gellert, R., Thompson, L., Clark, B. C., Sumner, D. Y., Fraeman, A. A., Kinch, Kjartan Münster, Madsen, Morten Bo, Mitrofanov, I. G., Jun, I., Calef, F. & Vasavada, A. R., 28 May 2017, In: *Geophysical Research Letters*. 44, 10, p. 4716-4724

Improved accuracy in quantitative laser-induced breakdown spectroscopy using sub-models

Anderson, R. B., Clegg, S. M., Frydenvang, Jens, Wiens, R. C., McLennan, S., Morris, R. V., Ehlmann, B. & Dyar, M. D., 1 Mar 2017, In: Spectrochimica Acta Part B: Atomic Spectroscopy. 129, p. 49-57

Recalibration of the Mars Science Laboratory ChemCam instrument with an expanded geochemical database

Clegg, S. M., Wiens, R. C., Anderson, R. B., Forni, O., Frydenvang, J., Lasue, J., Cousin, A., Payre, V., Boucher, T., Dyar, M. D., McLennan, S. M., Morris, R. V., Graff, T. G., Mertzman, S. A., Ehlmann, B. L., Belgacem, I., Newsom, H., Clark, B. C., Melikechi, N., Mezzacappa, A. & 5 others, McInroy, R. E., Martinez, R., Gasda, P., Gasnault, O. & Maurice, S., 1 Mar 2017, In: Spectrochimica Acta Part B: Atomic Spectroscopy. 129, p. 64-85 22 p.

AEGIS autonomous targeting for ChemCam on Mars Science Laboratory: Deployment and results of initial science team use

Francis, R., Estlin, T., Doran, G., Johnstone, S., Gaines, D., Verma, V., Burl, M., Frydenvang, Jens, Montañó, S., Wiens, R. C., Schaffer, S., Gasnault, O., Deflores, L., Blaney, D. L. & Bornstein, B., 2017, In: Science Robotics. 2, 7, eaan4582.

Fluidized-sediment pipes in Gale crater, Mars, and possible Earth analogs

Rubin, D. M., Fairén, A. G., Martínez-frías, J., Frydenvang, Jens, Gasnault, O., Gelfenbaum, G., Goetz, W., Grotzinger, J. P., Le Mouélic, S., Mangold, N., Newsom, H. E., Oehler, D. Z., Rapin, W., Schieber, J. & Wiens, R. C., 2017, In: Geology. 45, 1, p. 7-10 4 p.

In situ detection of boron by ChemCam on Mars

Gasda, P. J., Haldeman, E. B., Wiens, R. C., Rapin, W., Bristow, T. F., Bridges, J. C., Schwenzer, S. P., Clark, B., Herkenhoff, K., Frydenvang, Jens, Lanza, N. L., Maurice, S., Clegg, S., Delapp, D. M., Sanford, V. L., Bodine, M. R. & McInroy, R., 2017, In: Geophysical Research Letters. 44, 17, p. 8739-8748 10 p.

Redox stratification of an ancient lake in Gale crater, Mars

Hurowitz, J. A., Grotzinger, J. P., Fischer, W. W., McLennan, S. M., Milliken, R. E., Stein, N., Vasavada, A. R., Blake, D. F., Dehouck, E., Eigenbrode, J. L., Fairén, A. G., Frydenvang, J., Gellert, R., Grant, J. A., Gupta, S., Herkenhoff, K. E., Ming, D. W., Rampe, E. B., Schmidt, M. E., Siebach, K. L. & 3 others, Stack-morgan, K., Sumner, D. Y. & Wiens, R. C., 2017, In: Science. 356, 6341, 11 p., eaah6849.

Oxidation of manganese in an ancient aquifer, Kimberley formation, Gale crater, Mars: Manganese Fracture Fills in Gale Crater

Lanza, N. L., Wiens, R. C., Arvidson, R. E., Clark, B. C., Fischer, W. W., Gellert, R., Grotzinger, J. P., Hurowitz, J. A., McLennan, S. M., Morris, R. V., Rice, M. S., Bell, J. F., Berger, J. A., Blaney, D. L., Bridges, N. T., Calef, F., Campbell, J. L., Clegg, S. M., Cousin, A., Edgett, K. S. & 24 others, Fabre, C., Fisk, M. R., Forni, O., Frydenvang, Jens, Hardy, K. R., Hardgrove, C., Johnson, J. R., Lasue, J., Le Mouélic, S., Malin, M. C., Mangold, N., Martin-torres, J., Maurice, S., McBride, M. J., Ming, D. W., Newsom, H. E., Ollila, A. M., Sautter, V., Schröder, S., Thompson, L. M., Treiman, A. H., Vanbommel, S., Vaniman, D. T. & Zorzano, M., 28 Jul 2016, In: Geophysical Research Letters. 43, 14, p. 7398-7407

Silicic volcanism on Mars evidenced by tridymite in high-SiO₂ sedimentary rock at Gale crater

Morris, R. V., Vaniman, D. T., Blake, D. F., Gellert, R., Chipera, S. J., Rampe, E. B., Ming, D. W., Morrison, S. M., Downs, R. T., Treiman, A. H., Yen, A. S., Grotzinger, J. P., Achilles, C. N., Bristow, T. F., Crisp, J. A., Des Marais, D. J., Farmer, J. D., Fendrich, K. V., Frydenvang, J., Graff, T. G. & 3 others, Morookian, J., Stolper, E. M. & Schwenzer, S. P., 28 Jun 2016, In: Proceedings of the National Academy of Sciences USA (PNAS). 113, 26, p. 7071-7076

ChemCam activities and discoveries during the nominal mission of the Mars Science Laboratory in Gale crater, Mars

Maurice, S., Clegg, S. M., Wiens, R. C., Gasnault, O., Rapin, W., Cousin, A., Mangold, N., Nachon, M., Anderson, R. B., Lanza, N. L., Fabre, C., Lasue, J., Meslin, P. -Y., Dyar, M. D., Francis, R., Frydenvang, J., Gondet, B., Ehlmann, B. L., Herkenhoff, K. E., Johnson, J. R. & 14 others, Langevin, Y., Madsen, Morten Bo, Melikechi, N., Lacour, J. -, Le Mouélic, S., Lewin, E., Ollila, A. M., Schroeder, S., Sirven, J. -, Tokar, R. L., Toplis, M. J., d'Uston, C., Vaniman, D. T. & Vasavada, A. R., 6 Feb 2016, In: Journal of Analytical Atomic Spectrometry. 31, 4, p. 863-889

The potential of laser-induced breakdown spectroscopy for industrial at-line monitoring of calcium content in comminuted poultry meat

Andersen, M. S., Frydenvang, Jens, Henckel, P. & Rinnan, Åsmund, 2016, In: Food Control. 64, p. 226-233 8 p.

Concentration of mineral elements in wheat (*Triticum aestivum* L.) straw: genotypic differences and consequences for enzymatic saccharification

Murozuka, E., de Bang, T. C., Frydenvang, Jens, Lindedam, J., Laursen, Kristian Holst, Bruun, Sander, Magid, Jakob & Schjoerring, Jan K., 2015, In: Biomass & Bioenergy. 75, p. 134-141 8 p.

Metal binding in photosystem II super- and subcomplexes from barley thylakoids

Schmidt, Sidsel Birkelund, Persson, Daniel Pergament, Powikrowska, M., Frydenvang, Jens, Schjoerring, Jan K., Jensen, Poul Erik & Husted, Søren, 2015, In: Plant Physiology. 168, 4, p. 1490-1502 13 p.

Sensitive detection of phosphorus deficiency in plants using chlorophyll a fluorescence

Frydenvang, Jens, van Maarschalkerweerd, M., Carstensen, A., Mundus, S., Schmidt, Sidsel Birkelund, Pedas, P. R., Laursen, Kristian Holst, Schjoerring, Jan K. & Husted, Søren, 2015, In: Plant Physiology. 169, 1, p. 353-361 9 p.

Correcting for variable laser-target distances of laser-induced breakdown spectroscopy measurements with ChemCam using emission lines of Martian dust spectra

Melikechi, N., Mezzacappa, A., Cousin, A., Lanza, N. L., Lasue, J., Clegg, S. M., Berger, G., Wiens, R. C., Maurice, S., Tokar, R. L., Bender, S., Forni, O., Breves, E. A., Dyar, M. D., Frydenvang, J., Delapp, D., Gasnault, O., Newsom, H., Ollila, A. M., Lewin, E. & 4 others, Clark, B. C., Ehlmann, B. L., Blaney, D. & Fabre, C., 1 Jun 2014, In: Spectrochimica Acta Part B: Atomic Spectroscopy. 96, p. 51-60

Laser-Induced Breakdown Spectroscopy and Chlorophyll a Fluorescence Transients: In-situ Analytical Methods of the Future

Frydenvang, Jens, 2014, Department of Plant and Environmental Sciences, Faculty of Science, University of Copenhagen

An Optimized Calibration Procedure for Determining Elemental Ratios Using Laser-Induced Breakdown Spectroscopy

Frydenvang, Jens, Kinch, Kjartan Münster, Husted, Søren & Madsen, Morten Bo, 2013, In: Analytical Chemistry. 85, 3, p. 1492-1500

A new method for determination of potassium in soils using diffusive gradients in thin films (DGT)

Tandy, S., Mundus, S., Zhang, H., Lombi, E., Frydenvang, Jens, Holm, Peter Engelund & Husted, Søren, 2012, In: Environmental Chemistry (Print). 9, 1, p. 14-23 10 p.

Losses of essential mineral nutrients by polishing of rice differ among genotypes due to contrasting grain hardness and mineral distribution

Hansen, Thomas Hesselhøj, Lombi, E., Fitzgerald, M., Laursen, Kristian Holst, Frydenvang, Jens, Husted, Søren, Boualaphanh, C., Resurreccion, A., Howard, D. L., Jonge, M. D. D., Paterson, D. & Schjoerring, Jan K., 2012, In: Journal of Cereal Science. 56, 2, p. 307-315 9 p.