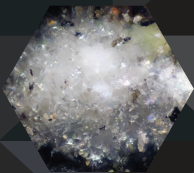


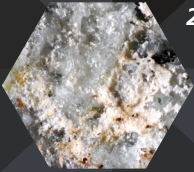


Carbon Minerals Verified Since December 2015

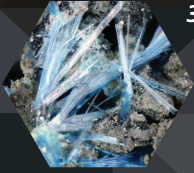
In 2015, researchers at the Carnegie Institution for Science and the University of Arizona used statistical models to predict that at least 145 of Earth's carbon-bearing minerals remained undiscovered. The Carbon Mineral Challenge was an effort to test that prediction. mineralchallenge.net



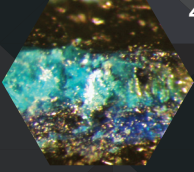
1 Abellaite (2015)
 $\text{NaPb}_3(\text{CO}_3)_7(\text{OH})$
Ibáñez-Insa, Elvira, Oriols, Llovet, Viñals
Yubileynaya pegmatite, Northern Region, Russia; Eureka Mine, Catalonia, Spain



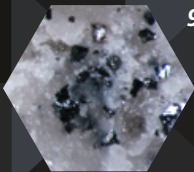
2 Tinnunculite (2016)
 $\text{C}_5\text{H}_4\text{N}_4\text{O}_3 \cdot 2\text{H}_2\text{O}$
Pekov, Chukanov, Yapaskurt, Belakovskiy, Lykova, Zubkova, Shcherbakova, Britvin, Chervonnyi
Glomsrudkollen Zinc Mines, Buskerud, Norway; Hüttwinklache, Salzburg, Austria; Montoso Quarries, Piedmont, Italy; Power station, Salzburg, Austria; Rasvumchorr Mt, Northern Region, Russia; Valletta Mine, Piedmont, Italy; Varana ophiolite, Italy



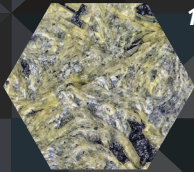
3 Marklite (2016)
 $\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2 \cdot 6\text{H}_2\text{O}$
Plášil, Kampf, Keuper, Škoda
Friedrich-Christian Mine, Baden-Württemberg, Germany



4 Middlebackite (2016)
 $\text{Cu}_2\text{C}_2\text{O}_4(\text{OH})_2$
Elliott
Iron Monarch open cut, South Australia, Australia; Val Gardena Sandstone exposure near San Lugano Pass, Trentino-Alto Adige, Italy



9 Roymillerite (2016)
 $\text{Pb}_{24}\text{Mg}_9(\text{Si}_{10}\text{O}_{28})(\text{CO}_3)_{10}(\text{BO}_3)(\text{SiO}_4)(\text{OH})_{13}\text{O}_5$
Chukanov, Jonsson, Aksenov, Britvin, Rastsvetaeva, Belakovskiy • *Kombat Mine, Otjozondjupa Region, Namibia*



10 Markeyite (2017)
 $\text{Ca}_9(\text{UO}_2)_4(\text{CO}_3)_{13} \cdot 28\text{H}_2\text{O}$
Kampf, Plášil, Kasatkin, Marty, Čejka
Markey Mine, Utah, USA



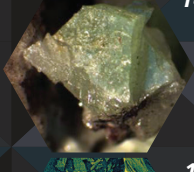
11 Stracherite (2017)
 $\text{BaCa}_5(\text{SiO}_4)_2[(\text{PO}_4)(\text{CO}_3)]_2\text{F}$
Galuskin, Krüger, Galuskina, Krüger, Vapnik, Pauluhn, Olieric
Hatrurim Formation, Negev, Israel



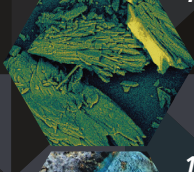
12 Wampenite (2017)
 $\text{C}_{18}\text{H}_{16}$
Mills, Kampf, Nestola, Williams, Leverett, Hejazi, Hibbs, Mrorsko, Alvaro, Kasatkin • *Wampen, Bavaria, Germany*



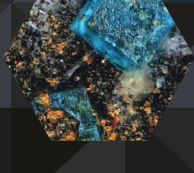
13 Triazolite (2017)
 $\text{NaCu}_2(\text{N}_3\text{C}_2\text{H}_2)(\text{NH}_3)_2\text{Cl} \cdot 4\text{H}_2\text{O}$
Chukanov, Zubkova, Möhn, Pekov, Belakovskiy, Van, Britvin, Pushcharovsky
Pabellón de Pica, Tarapacá, Chile



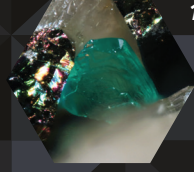
14 Somersetite (2017)
 $\text{Pb}_3\text{O}_3(\text{OH})_2(\text{CO}_3)_3$
Siidra, Nekrasova, Turner, Zaitsev, Chukanov, Spratt, Polekhovsky, Rumsey
Torr Works Quarry, Somerset, England, UK



15 Marchettiite (2017)
 $\text{C}_5\text{H}_4\text{N}_2\text{O}_3$
Guastoni, Nestola, Gentile, Zorzi, Andò, Lorenzetti, Mattioli • *SW slope of Mt. Cervandone, Piedmont, Italy*



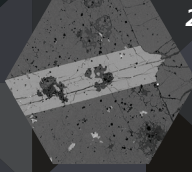
16 Ramazzoite (2017)
 $[\text{Mg}_8\text{Cu}_{12}(\text{PO}_4)(\text{CO}_3)_4(\text{OH})_{24}(\text{H}_2\text{O})_{20}] \cdot [(\text{H}_{0.33}\text{SO}_4)_3(\text{H}_2\text{O})_{36}]$
Kampf, Rossman, Ma, Belmonte, Biagioni, Castellaro, Chiappino
Mt. Ramazzo Mine, Liguria, Italy



17 Paddlewheelite (2018)
 $\text{MgCa}_5\text{Cu}_2(\text{UO}_2)_4(\text{CO}_3)_2(\text{H}_2\text{O})_{33}$
Olds, Plášil, Kampf, Bo, Burns
Klement Vein, Karlovy Vary Region, Czech Republic



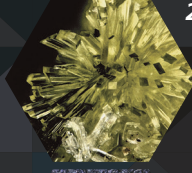
18 Phoxite (2018)
 $(\text{NH}_4)_2\text{Mg}_2(\text{C}_2\text{O}_4)(\text{PO}_3\text{OH})(\text{H}_2\text{O})_4$
Kampf, Celestian, Nash, Marty
Rowley Mine, Arizona, USA



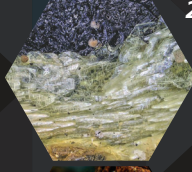
22 Aravaite (2018)
 $\text{Ba}_2\text{Ca}_{18}(\text{SiO}_4)_6(\text{PO}_4)_3(\text{CO}_3)_3\text{F}_3\text{O}$
Galuskin, Krüger, Galuskina, Krüger, Vapnik
Hatrurim Formation, Negev, Israel



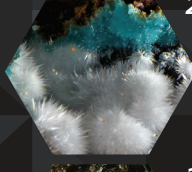
23 Akopovaite (2018)
 $\text{Al}_4\text{Li}_2(\text{OH})_{12}(\text{CO}_3)(\text{H}_2\text{O})_3$
Karpenko, Pautov, Zhitova, Agakhanov, Krzhizhanovskaya, Siidra, Rassulov
Asan-Usan Glacier, Kyrgyzstan



24 Uroxite (2018)
 $[(\text{UO}_2)_2(\text{C}_2\text{O}_4)(\text{OH})_2(\text{H}_2\text{O})] \cdot \text{H}_2\text{O}$
Kampf, Plášil, Nash, Němec, Marty
Burro Mine, Colorado, USA; Markey Mine, Utah, USA



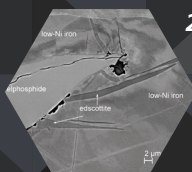
25 Pseudomarkeyite (2018)
 $\text{Ca}_8(\text{UO}_2)_4(\text{CO}_3)_{12} \cdot 21\text{H}_2\text{O}$
Kampf, Olds, Plášil, Burns, Marty
Markey Mine, Utah, USA



26 Šlikite (2018)
 $\text{Zn}_2\text{Mg}(\text{CO}_3)_2(\text{OH})_2 \cdot 4\text{H}_2\text{O}$
Sejkora, Grey, Kampf, Mumme, Bureš, Čejka • *Vladimír mine, Karlovy Vary Region, Czech Republic*



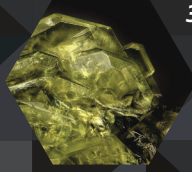
27 Davidbrownite-(NH4) (2018)
 $(\text{NH}_4)_5(\text{V}^{4+}\text{O})_2(\text{C}_2\text{O}_4)_2 \cdot [\text{PO}_{2.75}(\text{OH})_{1.25}]_4 \cdot 3\text{H}_2\text{O}$
Kampf, Cooper, Rossman, Nash, Hawthorne, Marty
Rowley Mine, Arizona, USA



28 Edscottite (2019)
 Fe_5C_2
Ma and Rubin
Wedderburn Meteorite, Victoria, Australia



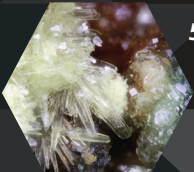
29 Lazaraskeite (2019)
 $\text{Cu}(\text{C}_2\text{H}_3\text{O}_3)_2$
Yang, Gibbs, Gu, Evans, Downs, Jabrin
Western End, Arizona, USA



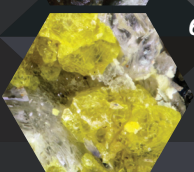
30 Natromarkeyite (2019)
 $\text{Na}_2\text{Ca}_3(\text{UO}_2)_4(\text{CO}_3)_{13} \cdot 27\text{H}_2\text{O}$
Kampf, Olds, Plášil, Marty, Burns
Markey Mine, Utah, USA



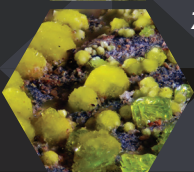
31 Metauroxite (2019)
 $\text{Al}_4\text{Li}_2(\text{OH})_{12}(\text{CO}_3)(\text{H}_2\text{O})_3$
Kampf, Plášil, Nash, Marty
Burro Mine, Colorado, USA



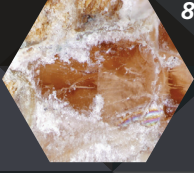
5 Leószilárdite (2016)
 $\text{Na}_6\text{Mg}(\text{UO}_2)_2(\text{CO}_3)_6 \cdot 6\text{H}_2\text{O}$
Olds, Sadargaski, Plášil, Kampf, Burns, Steele, Marty
Markey Mine, Utah, USA



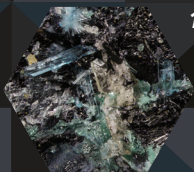
6 Ewingite (2016)
 $\text{Mg}_9\text{Ca}_3(\text{UO}_2)_{24}(\text{CO}_3)_{30}\text{O}_4(\text{OH})_{12}(\text{H}_2\text{O})_{138}$
Olds, Plášil, Kampf, Burns, Simonetti, Sadargaski • *Plavno mine, Karlovy Vary Region, Czech Republic*



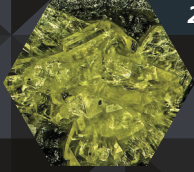
7 Braunerite (2016)
 $\text{K}_2\text{Ca}(\text{UO}_2)(\text{CO}_3)_2 \cdot 6\text{H}_2\text{O}$
Plášil, Mereiter, Kampf, Hloušek, Škoda, Čejka, Němec, Ederová
Svornost Mine (Einigkeit Mine), Karlovy Vary Region, Czech Republic



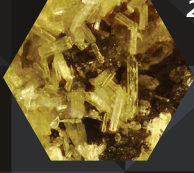
8 Parasite-(La) (2016)
 $\text{CaLa}_2(\text{CO}_3)_3\text{F}_2$
Menezes Filho, Chaves, Chukanov, Atencio, Scholz, Pekov, Magela da Costa, Morrison, Andrade, Freitas, Downs, Belakovskiy
Mula Claim, Bahia, Brazil



19 Fiemmeite (2018)
 $\text{Cu}_2(\text{C}_2\text{O}_4)(\text{OH})_2 \cdot 2\text{H}_2\text{O}$
Demartin, Campostrini, Ferretti, Rocchetti • *San Lugano Pass, Trentino-Alto Adige, Italy*



20 Meyrowitzite (2018)
 $\text{Ca}(\text{UO}_2)(\text{CO}_3)_2 \cdot 5\text{H}_2\text{O}$
Kampf, Plášil, Olds, Nash, Marty
Markey Mine, Utah, USA



21 Alterite (2018)
 $\text{Zn}_2\text{Fe}^{3+}_4(\text{SO}_4)_4(\text{C}_2\text{O}_4)_2(\text{OH})_4 \cdot 17\text{H}_2\text{O}$
Yang, Gibbs, Evans, Downs, Jabrin
Cliff Dwellers Lodge, Arizona, USA

Photo credits

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**DEEP CARBON
OBSERVATORY**