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Education:

Ph.D. 1980, Structural Engineering,
University of Texas, Austin;
M.S., 1975 Civil Engineering
Rensselaer Polytechnic Institute (RPI);
B.S., 1974 Civil Engineering, RPI.

Licenses: Registered Professional Engineer, District of Columbia PE7986.

Experience:

Beginning in 2013 Dr. Stone is Co-I and chief designer for the **ARTEMIS** (Autonomous Rover-airborne Radar Transects of the Environment beneath the McMurdo Ice Shelf) autonomous underwater vehicle – part of the SIMPLE project funded by NASA. ARTEMIS will be the first long range autonomous vehicle to travel under the Ross Ice Shelf in Antarctica. Its mission is to produce detailed up and down-look bathymetry of both the bottom of the Ross Sea and the underside of the Ross Ice Shelf in the vicinity of McMurdo Station and to test new stand-off bio-sensing technology based on deep ultraviolet laser induced fluorescence of microbes. The results will be compared with, and used to calibrate, over flights of the NASA Europa flyby mission's prime science instrument: a dual frequency ice penetrating radar that will quantify the thickness and characteristics of the Europa ice cap as a precursor to an ice-penetrating lander mission. A four month deployment to Antarctica was successfully fielded in Fall of 2015. ARTEMIS will also be a concept prototype for the Europa lander mission "fast mover" nuclear powered carrier AUV craft that will transport miniaturized ENDURANCE-class sub-bots for the exploration of complex, dangerous areas that may harbor microbial life in Europa's sub-surface ocean.

Beginning in 2011 Dr. Stone is PI for Phase 2 of the NASA-funded **VALKYRIE** (Very-deep Autonomous Laser-powered Kilowatt-class Yo-yoing Robotic Ice Explorer) project, to develop an intelligent autonomous "cryobot" for transporting AUV (autonomous underwater vehicle) science payloads through the ice caps of the outer planet icy moons. Laboratory and field tests in 2013 - 2015 are aimed at proving the novel concept of high energy optical power transport between a surface-based laser and the cryobot, which, in its final form, in Phase 3, will be designed to penetrate the 3 kilometer thick ice cap at the South Pole, enter the hypersaline South Pole Lake discovered from airborne radar, acquire a sediment sample from the floor and then autonomously return to the surface. VALKYRIE will use ice-penetrating SAR and active obstacle-avoidance to maneuver around hard obstacles it detects ahead of it in the ice column. The success of the South Pole VALKYRIE mission will be the final technology demonstration to enabling the Europa lander mission.

Dr. Stone was Co-I and chief designer for NASA's **ENDURANCE** (Environmentally Non-Disturbing Under-ice Robotic ANtarctiC Explorer) AUV. Designed for sub-ice autonomous navigation, exploration, and in-situ science, ENDURANCE was successfully fielded to Antarctica (3 months each during the Austral summers of 2008-9 and 2009-10) and produced complete 3D maps of permanently ice-covered, unexplored West Lake Bonney, 3D maps of the underwater junction of Lake Bonney with Taylor Glacier, and complete 3D aqueous chemistry characterization of the lake. ENDURANCE makes possible the cataloging of vast sub-glacial areas used as sensors of global environmental change. Missions of more than 4 kilometers were launched from a single melt hole in the 4 meter thick ice cap of West Lake Bonney. The vehicle used a 3-stage

autonomous navigation and docking system to return to and rise up through the melt hole. Of historical note, ENDURANCE autonomously explored Scott Pass in the Bonney Riegel narrows between East and West Lake Bonney, where Capt. Robert Scott's party took measurements on foot in 1903. One hundred seven years later ENDURANCE hovered where Scott stood, and created a 3D map which revealed a water level rise of 16 meters during that time period.

From 2003-2007 Dr. Stone was PI for the development of the **DEPTHX** (Deep Phreatic Thermal Explorer) prototype for the Europa lander third stage. Stone Aerospace designed, fabricated, integrated, and tested DEPTHX, with rapid prototyping leading to just an 8 month fabrication and integration cycle before first flight. DEPTHX demonstrated, spectacularly so, 3D real-time SLAM (geometric) navigation while in the process of autonomously (no tether) exploring the world's deepest hydrothermal spring in northern Mexico. On February 10, 2007, DEPTHX became the first robotic system to explore completely untethered into an unexplored subterranean hydrothermal vent. It built its own geometric maps as it explored and returned home on its own maps to within 15 cm of its homing position. DEPTHX also implemented a hierarchical science autonomy behavior in which the vehicle would populate 3D voxel space (diced from the world environment for which it automatically generated 3D models as it explored) with environmental data (DEPTHX had 7 environmental sensors onboard) and follow chemoclines or thermoclines to wall surfaces where it would then commence machine vision proximity operations, looking for changes in background coloration that might suggest the presence of microbial communities of interest. It would then autonomously extend a science probe and collect both liquid and solid core samples. An auxiliary onboard microscope and microfluidics system allowed for real-time machine vision tracking of microbe trajectories. On May 16, 2007, using autonomous SLAM navigation, DEPTHX discovered the bottom of cenote Zacaton at -335m and produced a stunning 3D map in the process. On May 26, 2007, DEPTHX explored into Cenote Zacaton where it discovered a chemocline (H_2S) at a depth of 114m. It autonomously made a decision to follow the chemocline to a nearby wall, collected a core sample, and returned home. The rock samples autonomously collected by DEPTHX at Zacatón (to depths of 280 meters) subsequently resulted in the discovery of 4 new **phyla** of bacteria (at a time when less than 100 were known on Earth).

Dr. Stone has 34 years of professional research, design, integration, and deployment experience in structures, dynamics, mechanical systems (including stress, vibration, and kinematics, 3-D and manufacture design, assembly, and mechanical dynamics) and scientific software development (data visualization, world sensing systems), advanced laser radar design, 3-D laser radar and sonar data processing, and automated/robotic systems design, integration, and test. From 1980-2004 he led efforts at NIST on the development of intelligent systems for autonomous radiation mapping; through-wall impulse radar tracking systems; robotic steel construction; LADAR-based terrain modeling systems; real-time discrete component laser tracking systems; the development of wireless intelligent sensing, control, and simulation systems for construction machinery; and web-based real-time construction information systems. He also organized and led a number of space-related projects at NIST including the conversion of the Shuttle external tank into an orbiting industrial laboratory; studies for Congress (OTA) on the ISS; and the development of a patented ultra-fast, precision space vehicle reaction control thruster. Through Stone Aerospace (SAS) he privately developed concepts for ultra-light re-entry systems beginning in 1995 into the current SAS SpaceBrake project.

Dr. Stone has co-founded five startup companies, holds 17 issued patents and 6 patents-pending, and serves on the board of directors for four corporations. He has worked on the design, development, and manufacture of numerous scientific and exploratory inventions: six generations of closed-cycle life support systems; a portable variable-depth underwater decompression habitat; a geo-registered imaging system for 3-D mapping of submarine tunnels; and an autonomous LADAR-based mobile 3-D mapping system for construction sites. In 2015 the SAS-designed Poseidon "Se7eN" rebreather began commercial production, currently manufacturing 1,500 units per year (www.poseidon.com).

In the summer of 2007 Dr. Stone co-founded, with Col. Dale Tietz (USAF, ret., former deputy directory of the Strategic Defense Initiative) and James Keravala (former COO of Surrey Satellite), the Texas-based Shackleton Energy Company (SEC) with the intent of raising private capital to develop, field, and operate refueling depots in low Earth orbit (LEO) supplied from raw materials extracted from the lunar Polar regions. The multi-national business plan calls for staged development of extraction, transport, and refining facilities

in both LEO and in the local vicinity of selected polar craters on the moon. Anticipated products include liquid water, gaseous hydrogen and oxygen, and cryogenic hydrogen and oxygen for a wide variety of markets initiating in LEO and eventually on the moon.

Professional Affiliations and Awards

American Institute of Aeronautics & Astronautics (1987-present)
American Society of Civil Engineers (1980-present)
Tau Beta Pi & Chi Epsilon National Engineering Honorary Fraternities

Member, Sub-glacial Lake Ellsworth Advisory Committee, AGU
Vice-Chairman, ISARC 2002 (International Symposium on Automation and Robotics in Construction)
Technical Chairman, ASCE Robotics 2000 Conference
Member, CII FIATECH advisory committee (2001-2004)
Chairman, ASCE Committee on Field Sensing and Robotics (1999-2001)
Member, CII Committee on RFID (radio frequency identification) (1998-2001)
Member, CII Committee on Wireless Ad-hoc Networks (1997-1998)
Member, AIAA Task Committee on Aerodynamic Decelerator Systems (1989-1991)

2011 Lowell Thomas Award for Exploration (Explorers Club)

Keynote Speaker 2013 International Unmanned Systems Conference (Washington, DC)
Keynote Speaker 2011 Bohemian Grove
Keynote Speaker 2010 MicroSoft TechReady 2010 conference, Seattle, WA
Keynote Speaker: 2009 Dasan Conference on Space Technology, Seoul, South Korea
Keynote Speaker: 2008 World Summit on Innovation and Entrepreneurship, Dubai, UAE.
Keynote Speaker: 2007 TED Conference, Monterey, CA.

IAARC Tucker-Hasegawa Award [2002] for international advancement in construction automation.
Willard Bascomb Quadrennial Prize for Underwater Exploration [3D mapping technology] (2001)
Silver Medal, U.S. Dept. of Commerce [for engineering excellence in novel technology] (2001)
ACI Structural Research Award [development of seismic damage model for bridges] (2000)
ACI Structural Research Award [design of novel precast seismic building system] (1997)
BFRL Communications Award [novel precast seismic building system invention] (1997)
BFRL Communications Award [structural performance during 1989 Loma Prieta Earthquake] (1990)
BFRL Communications Award [seismic design of bridge columns] (1988)
Bronze Medal, U.S. Dept of Commerce [structural performance during 1985 Mexico earthquake](1987)
T.Y. Lin Award, ASCE [resolution of problem with pre-cast box girder bridge design] (1985)
Wason Medal, American Concrete Institute [non-destructive evaluation of concrete] (1985)

Corporate Affiliations:

Chairman, Shackleton Energy Company (2007 – present)
CEO, Stone AeroSPACE (1998-present)
President, Piedra-Sombra Corporation, Inc. (2001-present)
Chairman, Cis-Lunar Development Laboratories, Inc. (1987-2004)
President, U.S. Deep Caving Team, Inc. (1980-present)
Member, Board of Directors of LunaCorp, Inc. (1989-2003)

Author of 140+ engineering publications
Author of more than 100 exploration-related publications

Author of 2 books on exploration, including the June 2002 release by Time-Warner of "**Beyond the Deep**" and the 1989 book "**The Wakulla Springs Project**". Principle subject of the book "**Blind Descent**" by James Tabor (2010).

Issued Patents

1) Digital Waterproof Lap Counter	US 4,932,045
2) Breathing Apparatus Mouthpiece	US 4,964,404
3) Breathing Apparatus Gas Routing Manifold	US 4,974,585
4) Breathing Apparatus	US 5,127,398
5) High Speed, Amplitude-Variable Thrust Control	US 5,271,226
6) High Speed, Amplitude Variable Thrust Control Method	US 5,431,342
7) Breathing Apparatus Mouthpiece	US 5,368,018
8) Three Degree-of-Freedom Telescoping Geometry Scanner	US 6,600,553
9) Underwater Vehicle with Sonar Array	US 8,220,408 B2
10) Auto Calibration / Validation of Oxygen Sensor in Breathing Apparatus	US 8,820,135
11) Mouth Piece for a Breathing Apparatus	US 8,770,195
12) Underwater Vehicle with Sonar Array	P-8595.3 (RE)
13) Optical Power Transfer System for Powering a Remote Mobility System for Multiple Missions	US 9,383,520
14) Optical Energy Transfer and Conversion System	US 9,090,315
15) Oxygen control in breathing apparatus	US 8,800,344
16) Mouthpiece for a Breathing Apparatus	US 8,770,195
17) Auto Calibration / Validation of Oxygen Sensor in Breathing Apparatus	US 8,820,135

Patents Pending

1) Power conversion module for use with Optical Energy Transfer and Conversion System	US-14/292,495
2) Autonomous Laser Powered Vehicle	US 14/335,863
3) System and Method for Aut. Rendezvous, Docking and Capture of Autonomous Und. Vehicle	US 14/887,262
4) System for Emergency Crew Return and Down-Mass from Orbit	US 15/067,292
5) Non-line of sight Optical Power Transfer Sys for Launching a Spacecraft into Low Earth Orbit	US 14/723,138
6) Fiber Optic Rotary Joint for use in an Optical Energy Transfer and Conversion System	US 14/723,161

Web Links

Shackleton Energy Company (mining the Moon):

http://www.economist.com/news/technology-quarterly/21603238-bill-stone-cave-explorer-who-has-discovered-new-things-about-earth-now-he

http://www.zawya.com/radio/default.cfm/sidDE120508101257562557
http://www.bbc.co.uk/worldservice/documentaries/2009/03/090313_theinterview_060209.shtml
http://www.ted.com/talks/bill_stone_explores_the_earth_and_space.html
http://www.space.com/10619-mining-moon-water-bill-stone-110114.html
http://www.spectrum.ieee.org/aerospace/space-flight/mining-the-moon
http://www.stoneaerospace.com/news-/SECdiscoverMay2010.pdf
http://www.ameinfo.com/150181.html

Antarctic Research:

http://www.stoneaerospace.com/news-/news-antarctica09-overview.php
http://antarcticsun.usap.gov/science/contenthandler.cfm?id=1780
http://www.stoneaerospace.com/news-/news-antarctica08-Nov26.php

Exploring the World's Deepest Hydrothermal Spring:

http://www.spectrum.ieee.org/computing/hardware/swimming-to-europa
http://www.spectrum.ieee.org/robotics/robotics-software/exploring-the-extreme
http://www.popsci.com/military-aviation-space/article/2007-03/depthx-mission-1-accomplished

Invention:

http://www.wired.com/wiredscience/2012/04/bill-stone-laser-powered-europa-rover/
http://www.spectrum.ieee.org/geek-life/tools-toys/winner-poseidon-discovery
https://www.popsci.com/node/9266

Deep Cave Exploration:

http://www.npr.org/2013/11/08/201156341/are-earth-s-deepest-caves-the-last-frontier

http://www.newyorker.com/magazine/2014/04/21/in-deep-2
http://tunein.com/topic/?TopicId=48803663
http://www.wired.com/wired/archive/12.12/stone.html
http://ngm.nationalgeographic.com/ngm/0402/online_extra.html
http://video.google.com/videoplay?docid=5797001505961854840
http://www.usdct.org/
http://www.usdct.org/j2_2009.php
http://www.usdct.org/J2_2009_NSS_LowRes.pdf
http://www.nationalgeographic.com/adventure/9905/profile.html
http://ngm.nationalgeographic.com/ngm/caverace/week9/index.html

Europa Mission Engineering:

http://www.space.com/22146-robotic-exploration-europa-incredible-tech.html

Engineering Experience:

President
Stone AeroSPACE
Austin, Texas
1998-present

This organization was founded in 1998 to address advanced robotic and deployable system applications for manned and unmanned space exploration. The first major project purely under the Stone Aerospace banner was the NASA DEPTHX vehicle, followed three years later by the ENDURANCE project. The company has several large projects currently underway, including VALKYRIE and ARTEMIS. In addition the company is currently completing system integration of a miniaturized version of the Antarctic-proven ENDURANCE bot, known as SUNFISH. SUNFISH will allow autonomous exploration and mapping of subaquatic environments down to one kilometer depth. With a weight of 45 kg and a range of 5 kilometers it is the first commercially available device to utilize Stone Aerospace's patented 3D real-time SLAM engine for navigation, which allows it to use 3D features for tracking its position.

In addition to the above projects, Stone Aerospace has been the prime designer for the Poseidon line of diving rebreathers, beginning with the world's first recreational fully-closed cycle rebreather, the Poseidon Discovery Mk6 -- a computer controlled 15 kg device with a depth rating of 60 m and a depth-independent duration of 3 hours, about the size of a briefcase. The device is currently in large scale production and is intended to replace normal Scuba. The PADI, SSI, and TDI diving training agencies are now offering instruction in its use. Most recently Stone Aerospace has collaborated with Poseidon on the development of the T60 Technical Diving unit. This is a 100 m depth, six hour range system that handles synthetic breathing gases (trimix, heliox), plug-and-play device architecture, and real-time decompression management.

Stone Aerospace consists of a network of world-class consultants in structural, mechanical, electrical, and aerospace design combined with computer architecture and embedded systems designers and software programmers. As a whole, the team specializes in the design of novel, computer controlled gagetry, from hand-held to vehicle-sized.

Leader
Construction Metrology and Automation Group
National Institute of Standards and Technology (NIST)
Gaithersburg, Maryland
1980 - 2004

Dr. Stone established and led the Construction Metrology and Automation group (CMAG) at NIST in Gaithersburg, Maryland for seven years before stepping down to take a consulting senior scientist position at the lab while leading the DEPTHX and ENDURANCE efforts at Stone Aerospace. As leader of CMAG, major program management at NIST included the development of real-time field sensing systems in support of the CONSIAT Program (Construction Integration and Automation Technologies). This was a $2M/year program focused on bringing robotics (fully autonomous machinery) and IT to the construction industry.

Previous project management included the development of the National Construction Automation Testbed (NCAT -- a government/industry consortium to investigate data uplink issues for construction sites and to develop augmented simulation systems for component tracking and vehicle control at construction sites), and the National Advanced Manufacturing Testbed (NAMT) program in construction automation (in which a 30-ton full-scale bridge crane was remotely monitored using live, 3D data-driven augmented reality, wireless video and audio, and high speed net trunking). This latter capability was selected for inclusion in the Highway One NGI Congressional demonstration for the Next Generation Internet.

Bill's final research work at NIST focused on the development of Next Generation LADAR (laser radar) systems; through-wall impulse radar tracking systems; and the development of fully autonomous construction crane "pick and place" systems. In the latter project work was aimed at developing robust 3D laser radar real-time docking procedures for automated placement of construction components.

At NIST Dr. Stone also worked on a number of space-related projects including the conversion of the Space Shuttle external tank into an orbiting industrial laboratory, studies for Congress on the international space station, and the development of an ultra-fast, precision space vehicle reaction control thruster.

Chairman of The Board
Cis-Lunar Development Laboratories, Inc.
Gaithersburg, Maryland
1987 - 2004

Dr. Stone founded Cis-Lunar Development Laboratories in 1984 to design and develop advanced life support apparatus for Undersea and Space exploration. Key inventions and products developed by Dr. Stone at Cis-Lunar include:

- **1980:** The first fully composite diving apparatus. Developed in collaboration with NASA, this was a dual-tank backpack utilizing S-glass composite pressure vessels running at 375 bar. Special tank valves and regulator conversions were developed. These were used in the 1981 and 1984 Huautla expeditions. See the website: http://www.usdct.org/usdct_expeditions/rio_iglesia.htm

- **1987:** MK-1 rebreather. Developed between 1984 and 1987. This was the first fully redundant closed cycle life support architecture. It was an original design that included twin gas processors, four onboard computers, and the ability to manually cross connect the two halves of the system in the event of emergencies underwater. It weighted 100 kg and had a range of 48 hours. This was used dramatically on December 3 and 4 of 1987 when Dr. Stone spent 24 hours continuously underwater using the prototype device. First self-contained diving apparatus to make use of lithium hydroxide as a carbon dioxide absorbent. First rebreather to have a hydrophobic absorbent canister. See the website: http://www.usdct.org/usdct_expeditions/wakulla1987.htm

- **1987:** Portable, Variable-depth Underwater Decompression Habitat. This was a six-person system that used a novel hemispherical inflatable living quarters ballasted by 10,000 kg of lead. The system was 1 ton positively buoyant and connected to a deep anchor through a manual chain hoist that could be used to raise or lower the habitat. In this manner returning exploration teams at Wakulla Springs could perform decompression in dry comfort. See the webs
http://www.usdct.org/usdct_expeditions/wakulla1987.htm
http://www.usdct.org/photo_gallery/pg1987.dir/habitat_in.htm

- **1989:** MK-2 rebreather. A much more compact and improved dual-rebreather that included six onboard computers, a head-up display, and a more compact gas management system. First twin counterlung rebreather. The MK-2 had a range of 12 hours. The prototype weighed 50 kg.

- **1991:** MK-3 rebreather. An improved version of the MK-2 with more reliable electronics, automatic diluent addition and a new CO2 absorbent canister design. Nine units were produced and field tested.

- **1994:** MK-4 rebreather. Substantially improved version of the MK-3 including field-tested mouthpiece that converted from open to closed circuit operation. New control electronics, significant software upgrades including operational real-time decompression status and real-time selection of oxygen setpoint. See the website: http://www.usdct.org/usdct_expeditions/huautla1994.htm

- **1996:** MK-5P Mod 0 rebreather. Commercial production 40 units. Substantial improvements over the MK4, including condensate minimizing design; rapid field maintenance features (including access to oxygen sensors, removal and replacement of CO2 canister, and removal of condensate); and vastly

improved electronics resulting in a size reduction of nearly 50% of that of the MK4. See the website: http://www.usdct.org/rebreathers.htm

- **1998:** MK-5P Mod 1 rebreather. Substantial improvements to the MK5-Mod-0 based on user field use. Included substantial improvements in the software operating system, backpack design, offboard gas connection and selection system; decompression download (tissue tension model); decompression planner; and data download capabilities. See the website: http://www.usdct.org/Updates/dec23.htm and http://www.usdct.org/Updates/dec29.htm

- **1999:** 3D Digital Wall Mapper. A revolutionary submarine imaging system that uses a helical sonar array and an inertial guidance system to image the complete geometry of a submerged tunnel. The system mounts to a modular diver propulsion vehicle that can be controlled by a towed diver. The diver can program the system while underwater. The internal control network includes 8 computers that interface to 37 sensors and two servo-driven pitch/roll canard diving planes. Software includes onboard control system; laptop-based data download program; and Silicon Graphics based visualization in 3D. See the website: http://www.usdct.org/mapper.htm and http://www.usdct.org/Updates-Jan/jan10.htm and http://www.usdct.org/Updates-Feb/feb07.htm During December 1998 through February 1999 the 3D Digital Wall Mapper collected 10,000,000 3D data points inside Wakulla Springs. These data have not only formed the basis for the world's first fully three-dimensional cave map but have also become a benchmark test data set for automated meshing algorithms operating on sparse 3D point cloud data.

- **1999:** Long Range Diver Propulsion Vehicle (aka the "Fat Man"). Designed for operation at depths of up to 150 meters the Fat Man used nickel metal hydride industrial batteries and a custom designed motor to achieve a burn time of greater than 6-1/2 hours at 1.2 meters/second for a fully loaded diver. The system weights 63 kg in air but is absolutely neutral in water. This was the main propulsion system for the Wakulla 2 expedition. See the website: http://www.usdct.org/scooters.htm

- **1999:** Dual MK5-P system. Two versions of fully redundant rebreathers were developed for the Wakulla 2 expedition. These included a vehicle mounted version that employed a novel breathing hose quick-connect designed by Stone (http://www.usdct.org/Updates/dec21.htm) and a second design that placed both MK5 rigs in a single backpack (http://www.usdct.org/Updates-Feb/feb06.htm). Both systems have a range of 20 hours at 150 meters.

- **1999:** Modular Floating Decompression Habitat. This was a novel implementation of commercial saturation diving equipment. A series of modular micro-barges was assembled and a standard saturation decompression habitat and personnel transfer capsule were mounted on top. A special launch system with dual pneumatic hoists was developed to handle deployment and docking of the pressurized personnel transfer capsule. This system was used for 32 3D mapping missions during the National Geographic Society expedition to Wakulla Springs, Florida in 1999. See the website: http://www.usdct.org/Updates/dec08.htm and http://www.usdct.org/Updates-Feb/feb20.htm

Expeditionary Experience:

Dr. Stone is recognized as a world authority on cave exploration. He has led or participated in 65 international caving expeditions in the last 41 years during which he has spent more than eight years in foreign countries, mostly in southern Mexico, working in the extremely deep caves of the Sierra Mazateca (Sistema Huautla) and Sierra Juarez (Cueva Cheve) regions. He has logged 534 days based from subterranean camps, many greater than a kilometer deep. The longest single stay was 19 days at Camp 4, -1209m deep in the J2 cave system in southern Mexico. Dr. Stone has been the principal architect behind the exploration of Mexico's Huautla Plateau and the exploration of Sistema Cheve. He is credited with initiating the Technical Diving revolution first by introducing safe procedures for work at great depths underwater in caves[1] and later reducing these techniques to practice in the 1989 book entitled "The Wakulla Springs Project." Dr. Stone's invention of advanced closed cycle life support systems for cave diving culminated in the historic 1994 National Geographic Society expedition to Huautla (which reached -1475 meters depth) and the 1999 expedition to Wakulla Springs, Florida where the first fully 3D cave map was produced. In the spring of 2003 he led a 3-month international expedition to Cueva Cheve that netted a depth of -1484 meters at a distance of 9.3 kilometers from the nearest entrance. He is the president of the United States Deep Caving Team, Inc., a non-profit organization dedicated to fielding multi-disciplinary teams to explore the world's most challenging caves. He most recently led the ***2004, 2005, 2006, and 2009 Sistema Cheve*** expeditions, which led to the discovery of "J2", which ultimately reached a depth of -1222 meters at a distance of 11 kilometers from the nearest entrance and currently represents the most remote point reached inside the Earth by human exploration teams. Exploration at J2 continues and a 4 month international return expedition is planned for 2013. The 2003 and 2004 expeditions were chronicled by National Geographic at:

www.nationalgeographic.com/ngm/caverace

Some of the more significant projects during the past 32 years are summarized here:

1980 Rio Iglesia Expedition

In 1980 he led the U.S. team on the four-month Rio Iglesia Expedition to the Huautla Cave System of southern Mexico, during which the team reached a point 1222m beneath the surface, establishing the Huautla System as the world's third deepest cave. Dr. Stone made a solo dive in Li Nita Cave at a depth of –1030m which led to a connection with the Sotano de San Agustin, thus achieving the –1222m depth.

Expedition Website: http://www.usdct.org/rio_iglesia.php

1981 Agua de Cerro Expedition

In 1981, as leader of the Agua de Cerro Expedition, Dr. Stone dove 285m into a flooded corridor at the bottom of the Huautla System (-1353m) in an effort to reach an air filled continuation leading towards the center of the plateau. This was the longest exploratory dive ever achieved at the bottom of a deep cave and marked the first use of fully composite filament wound Scuba apparatus – a new system designed by Dr. Stone and NASA. 4-1/2 month expedition.

Expedition Website: http://www.usdct.org/agua_de_cerro81.php

1982 Mount McKinley Ice Caves Expedition

[1] Beginning with the 1985 expedition to Wookey Hole in England which made use of Trimix breathing gas; followed by the regular use of heliox 80/20 during the International Blue Holes Expedition in the summer of 1987 and culminating with the National Geographic Society expedition to Wakulla Springs, Florida in the fall of 1987 during which more than 100 dives were made using heliox followed by nitrox and pure oxygen decompression. The procedures developed for the latter project became the basis for Technical Diving worldwide.

In 1982 Dr. Stone was the co-leader of a climbing/exploration team to Mount McKinley, Alaska during which he directed an exploration program of the ice caves of the Muldrow Glacier. On the same expedition he was a member of the summit assault team which successfully reached the top of McKinley after 40 days on the mountain. In the fall of 1982 he served as the cartographer in a five person team of specialists called in by the Puerto Rican government to develop a national park at the Rio Camuy Cave System on the northwest corner of the island.

1984 Pena Colorada Expedition

In the spring of 1984 he led the multi-national Pena Colorada Expedition in an effort to dive through the artesian springs at the base of the Huautla Plateau and to explore 10 kilometers upward towards the point reached in 1981. The expedition, which was in the field for four months, eventually succeeded in reaching a point more than four kilometers into the mountain. Twenty five percent of this distance was totally underwater, a factor which was to make this the most logistically complex cave exploration project in history. Among the many "firsts" achieved by this expedition was the establishment of long duration, remote subterranean operations bases beyond a series of flooded corridors (used for 27 days) and the use of pre-conditioning simulations to train the team in the techniques of cave diving.

Expedition Website: http://www.usdct.org/pena_colorada84.php

1985 International Expedition to Wookey Hole, Somerset, England

During the summer of 1985 he was a member of a six person team attempting to resolve the internal hydrology of the Mendip Hills of Somerset, Great Britain. Entering via the artesian springs at Wookey Hole, the team dived through 600m of underwater tunnels and set a five day subterrenean camp at a point two kilometers from the entrance. Using composite diving apparatus and a 36% helium gas mixture the team extended the limit of exploration to a depth of 68m underwater in the final tunnel before discovering an impassable restriction. This was the first use of helium mixtures at a remote underground exploration site.

1987 National Geographic Society Wakulla Springs Expedition

In the fall of 1987 he served as expedition leader for the 3-month Wakulla Springs Project, an international effort to study and chart the unknown reaches of Wakulla Springs, Florida (the site originally believed to be the "fountain of youth" by Ponce de Leon). This project was the focus of substantial advances in life support technology and cave diving techniques, including the use of habitats, diver propulsion vehicle-borne sleds, multi gas decompression, and near-saturation work at average depths in excess of 100m. The team successfully explored and mapped 3.3 kilometers of flooded galleries, the largest of which measured 50m wide by 20m tall. The project achieved national media attention and a documentary film aired in Britain in August of 1988 and later on National Geographic Explorer in the United States.

Expedition Website: http://www.usdct.org/wakulla87.php

1988, 1989, 1990, and 1991 Cueve Cheve Expeditions

From 1988 through 1991 Dr. Stone participated in four expeditions to Cueva Cheve, Oaxaca, Mexico during which time it became the deepest cave in the Western Hemisphere at - 1386m. Bill was involved with the initial exploration of the cave below the 800m level to its present depth (at a point 11 kilometers traverse distance from the entrance) and with the initial establishment of all three underground camps used to further the exploration front. He assumed logistics planning responsibilities for the diving effort in 1991 which netted the current depth.

Training Missions 1992-1993 for the San Agustin Expedition

In 1992 and 1993 Dr. Stone organized and led two 2-month training missions for the San Agustin Expedition. These involved participants from six nations and represented the first extensive use of closed cycle life support apparatus (rebreathers) for use in cave diving. During these two years the team logged more than 200 underwater missions and 30 hyperbaric chamber runs to depths as deep as 110 m, swimming distances in excess of 4 km, and for durations in excess of 6 hours continuously underwater. Decompression was calculated using onboard software. There were no incidences of DCS (bends). All rebreather missions were carried out with a perfect safety record. The 1993 effort also involved a realistic expedition simulation at 1200 m elevation in the Cueva Infiernillo in northern Mexico. During this exercise rebreathers were broken down into modular packs, transported over 5 km of rugged terrain and to the bottom of the 72 km long Sistema Purificacion (for which Cueva Infiernillo is the lower entrance). The MK-4 rebreathers were re-assembled at a week-long underground camp and used for eight flawless exploratory missions. The team discovered 500 m of underwater galleries which reached a depth of 57 m. This extended the depth of the system to 954 m, making it the 5th deepest cave in the Western Hemisphere.

1994 National Geographic Society San Agustin Expedition

From January 15th through June 1, 1994 (4-1/2 months) Dr. Stone led an international team of explorers to the Huautla Cave system in Oaxaca, Mexico. Using MK4 rebreathers, the team succeeded in exploring through the San Agustin Sump (an underwater tunnel beginning at a depth of -1353m) and ultimately reaching a depth of -1475m. The team spent a total of 44 days based from underground camps below -1000m. This established the Huautla System as the 5th deepest cave system in the world. The end of the cave, at -1475m and beyond 700m of flooded tunnels at the -1353m level, is presently considered the most remote point yet reached by humans inside the earth. The expedition story was published in the September 1995 issue of National Geographic Magazine as well as the Washington Post Magazine and Outside Magazine. It has also appeared in several elementary school science textbooks, Italy's Focus Magazine, and has been translated into six foreign languages including Russian and Japanese.

Expedition Website: http://www.usdct.org/huautla94.php

1999 National Geographic Society Wakulla 2 Expedition

In 1999 Dr. Stone led the 3-month National Geographic Society Expedition to Wakulla Springs, Florida, USA. This was the most technical cave diving expedition ever fielded and it resulted in the production of the world's first 3D cave map. For this expedition the Cis-Lunar engineering design team (including Bill Stone, Nigel Jones and Mike Stevens) invented a series of novel inventions including a 3D digital autonomous underwater imaging system; a dual version of the MK5 rebreather which had a range of 20 hours at 100m depth underwater; the world's longest range diver propulsion vehicle (6-1/2 hour travel time at 1.2 meters/second); and a modular field-deployed floating hyperbaric decompression habitat and a mobile personnel transfer capsule that would retrieve returning exploration teams from –30m under pressure. The team developed custom decompression procedures that involved laptop computer interrogation of the MK5 backpack to generate the decompression habitat portion of the surfacing schedule – something that had never before been accomplished. The team conducted 32 deep level missions inside Wakulla Springs with average bottom times of 4.5 hours at 100m water depth. The expedition was the first to make routine scientific diving below –100m underwater. For several months the team fielded a significant mission each day for three days in a row followed by a day of maintenance whereupon the cycle would be started again. More than 23 kilometers of underwater tunnels were mapped in 3D. The resulting data include 10,000,000 survey points. This project was featured as the cover story in National Geographic Adventure magazine (Summer 1999) and as a documentary film on the National Geographic Explorer TV Channel (under the title "Mapping the Labyrinth"). A total of 234 MK5 rebreather dives were logged during the Wakulla 2 expedition.

Expedition Website: http://www.usdct.org/wakulla2.php

See also:

http://www.nationalgeographic.com/adventure/9905/profile.html [interview]
http://www.nationalgeographic.com/voices/ax/frame.html [Wakulla 2 online]

2001 Inner Space Odyssey Expedition

From January 15, 2001 to April 30, 2001 Dr. Stone co-led the 2001 Inner Space Odyssey Expedition. The objectives of the expedition were to reach a point deeper inside the earth than humans have ever gone. The expedition involved an Olympic-class international team comprised of deep vertical cavers, big wall climbers, and cave divers. The expedition succeeded in mapping 3.8 kilometers of new galleries inside the Huautla Plateau, the Sierra Juarez, and the Sierra Tamaulipas. Significantly, the resurgence springs for the Huautla Cave system were cracked at a distance of 1059m upstream from the spring rising using MK5 closed cycle rebreathers designed by Dr. Stone. The tunnel, which reached a maximum water depth of 65m, surfaced inside the east wall of the Pena Colorada canyon, thus opening a "back door" to the heart of the Huautla plateau. A future 4-month expedition will be required to exploit this breakthrough, owing to the logistics of setting up a long duration camp beyond such a tremendous underwater distance.

2003 Sistema Cheve Expedition

Dr. Stone led a 55-person team from 9 countries on a 3-month effort to be the first exploration party to crack -2000 meters depth in a natural cavern. The team spent 33 days below the -1,000 meter level of Sistema Cheve in Oaxaca, Mexico. The lead team, of which Dr. Stone was a member, dived through 500 meters of flooded tunnels at the -1360 m level before emerging in an air-filled river canyon. This was followed to a depth of -1484 m at a point 9.3 kilometers from the nearest entrance to a point where a ceiling collapse blocked the way forward. This point presently represents the most remote location yet reached by humans inside the planet. National Geographic Magazine ran stories on this expedition in the February 2004 and July 2004 issues.

2004 Sistema Cheve Expedition

Dr. Stone led a 40-person team from 7 countries on a 2-month effort to explore the uncharted cloud forest highlands to the north of Cueva Cheve in the Mexican state of Oaxaca. Following six weeks of difficult recon missions in extraordinarily difficult terrain, the team hit upon a series of entrances that drained the floor of a previously unknown high elevation closed valley. The second entrance in this series, known as "J2" quickly became the focus of the entire team. During the final two weeks the team rigged every meter of rope left and reached a depth of -450 m at the head of a shaft dropping into a large chamber shortly beyond the subterranean confluence of two large streams. The upper portions of J2 have winds that hit speeds in excess of 30 mph, which strongly suggest that J2, alone, may be a contender for a -2,000 m system. The expedition was reported live (via satellite) at

www.nationalgeographic.com/ngm/caverace .

2005 J2 Expedition

Dr. Stone led a 52-person team from 8 countries from March 19 – May 15, 2005 to explore the newly discovered J2 cave system in Oaxaca, Mexico (see above). The team reached a depth of -1101 meters at a distance of 6 kilometers from the entrance before logistics issues forced a retreat.

2006 J2 Expedition

Dr. Stone co-led a 45-person team from 11 countries from March 25 – May 30, 2005 to continue exploration of J2. The team established Camp 3 at a depth of -1150m and 9 kilometers from the entrance and continued on until reaching Sump 2 at a depth of -1209 m, 10 kilometers from the entrance. The sump was

dived for 150 meters (at 8 meters depth) to a 30 meter diameter dome chamber. On the downstream side Sump 3 was discovered. This effort required a 10 day effort with more than 20 support personnel to enable one diver to make the initial exploration of Sump 2 using traditional Scuba.

2007 Sistema Zacaton Project

Between January and the end of May 2007 the NASA DEPTHX autonomous robotic exploration vehicle, designed and developed by Stone Aerospace, was used to completely map the entire Sistema Zacaton hydrothermal spring complex, including Cenote Zacaton, Cenote Caracol, Pozo Verde, and Pozo La Pilita. Prior knowledge of these springs was extremely limited and no knowledge existed of their overall extents and morphology. Cenote Zacaton was, until this expedition, tragically known for 1994 deep diving mission by Sheck Exley and Jim Bowden. Bowden reached a depth of 282m without reaching the bottom; Exley was lost and no further work was done until May of 2005 when the DEPTHX team began testing 3D imaging sensors for the autonomous vehicle. On May 16, 2007 DEPTHX autonomously bottomed Zacaton at a depth of 335 meters. On May 26, 2007 DEPTHX autonomously descended to a depth of -114m in Zacaton where it discovered a chemocline (hydrogen sulphide layer). It followed this to the wall of the hydrothermal vent shaft and collected a core sample from the wall. This sample, along with others taken autonomously to depths of 273 meters in Zacaton, have led to the discovery of 6 new divisions of bacteria. Prior to this mission less than a hundred divisions were known to the world.

For further details see:

http://www.stoneaerospace.com/news-/news-zacaton-mission1.php

http://www.stoneaerospace.com/news-/news-zacaton-2nd-mission1.php

http://www.stoneaerospace.com/news-/news-zacaton-mission3-01.php

2008/2009 and 2009/2010 Lake Bonney Missions

From November 4 2009 to January 2009 and October 2 to December 30, 2009 Dr. Stone co-led the ENDURANCE robot development team to Lake Bonney, Antarctica, where it became the first object, human or robotic, to explore the sub-ice world of Lake Bonney as part of Phase 2 on the path-to-mission for the NASA Europa lander mission. See notes above (General) and the following two websites:

2008-2009 ENDURANCE Mission:

http://www.stoneaerospace.com/news-/news-antarctica08-Nov26.php

2009-2010 ENDURANCE Mission:

http://www.stoneaerospace.com/news-/news-antarctica09-overview.php

2009 J2 Expedition

A 46 person international team from 10 countries was led by Dr. Stone to continue exploration of the J2 cave system in southern Mexico. The return expedition to was predicated on the development of a “micro-rebreather” that would enable high performance life support technology to be transported to the extremely remote underwater tunnels at the current limit of exploration. That device took three years to develop and is now the commercial Poseidon MK6 (see above). The international team trained during the fall of 2008 and was in the field from March 5 through the end of May 2009. A total of 40 days were spent working from underground camps with the longest contiguous push being 19 days (from May 6 to 24, 2009). Camp 4 (-1209 meters depth) was established at 10 kilometers from the entrance and beyond 200 meters of underwater tunnels. Two teams of two spent 4-1/2 and 7-1/2 days respectively working from this camp to push the most remote reaches of the cave. The final team explored Sump 4 (370 meters long) which

appears to be rising toward an intersection with the San Miguel gorge, where an anticipated descent of more than 600 meters vertically will take place. The current depth of J2 is -1222 meters, mid-way into Sump 4. Plans are currently underway for a return in 2012. See the following website for further details:

http://www.usdct.org/j2_2009.php

2013 J2 Expedition

A 14-nation, 65 person international return to J2 was fielded from February 1 to May 8, 2013. See the www.usdct.org website for details. Logistics of the operation are well described in the 2009 report link listed above. In 2012 the team trained with advanced closed-cycle life support systems in two groups: those that would provide logistics support through the 200-meter-long Sump 2 (at -1,209m) and those who would complete the exploration of Sump 4, establish Camp 5, and potentially continue to a depth of 2,000+ meters. The expedition proceeded along schedule for the first 2-1/2 months. On March 15, 2013 the lead team successfully passed Sump 4 at 520 meters length and surfaced into a large air-filled tunnel carrying the subterranean river. A massive effort ensued to place a 3-person exploration and mapping team beyond Sump 4 and to establish Camp 5 there to allow for a 30 day final push. However, once the bivouac had been established on April 9, 2013 the cave was discovered to suddenly end just 300 meters beyond the end of the underwater tunnel. The main tunnel was filled to the roof by the same type of deposited rock that forms stalagmites; the river filtered through a crack only a few centimeters wide, both preventing further human exploration. However, during the month long “derig” (when equipment was being removed from the cave) a 4 person climbing team scaled an incoming dome (a vertical shaft leading upwards) not 500 meters before the start of the first underwater tunnel. This up-trending tunnel carried a gale force wind up into it. The climbing team scaled 270 meters vertically upwards (almost the height of the Empire State building) before running out of time. Where that wind goes remains a major mystery inside the mountain.

Dr. Stone is a fellow of the Explorers Club (New York) and the National Speleological Society. In 1980 he recieved a commendation from the United States Embassy in Mexico City for assistance he and the U.S. team rendered in the evacuation from minus 600m of members of the 1980 Polish Expedition to the Sotano de San Agustin, Mexico. This was at the time the deepest rescue in the history of speleology.

Dr. Stone was a semi-finalist in the NASA astronaut selection process in 1989 and logged 240 hours as a licensed private pilot.

He has written more than 100 articles relating to exploration and equipment development, was the principal author of the book The Wakulla Springs Project, and has authored portions of two other books. In July 2002 Time-Warner published Beyond the Deep, Dr. Stone’s book describing 30 years of exploration on Mexico's Huautla Plateau.

Engineering Publications

NASA VALKYRIE Project

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Large Scale Structures

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William C. Stone: Recent Technical Presentations

2012

Stone, W.C. , "Project VALKYRIE: A Novel Approach for Sub-Glacial Lake Access and Sample Return," Scientific Conference on Antarctic Research (SCAR 2012), Portland, OR, July 18, 2012.

Stone, W.C. , "Hazard Analysis and Human Factors or How we can Engineer Rebreathers to be as Safe as OC Scuba," Rebreather Forum 3.0 (RF3), Orlando, FL May 19, 2012.

Stone, W.C. , "Sub-Ice Exploration of West Lake Bonney: Summary of the ENDURANCE Project," Astrobiology Science Conference (AbSciCon 2012), Atlanta, GA, April 19, 2012.

Stone, W.C. , "Project VALKYRIE: A Next-Gen Cryobot for Sub-glacial Access," Astrobiology Science Conference (AbSciCon 2012), Atlanta, GA, April 19, 2012.

Stone, W.C. , "Three Frontiers to Challenge our Imagination," The Explorers Club, New York, NY, April 12, 2012.

Stone, W.C. , "DEPTHX and ENDURANCE: Autonomous Exploration of the World's Deepest Hydrothermal Spring and Two Missions to Antarctica," Slovenian Academy of Science, Ljubljana, Slovenia, February 9, 2012.

Stone, W.C. , "Explorations at Wakulla Springs, Florida1987 and 1999," International TECHMEETING 2012, 14th Annual Technical Diving Conference, Bratislava, Slovakia, February 5, 2012.

Stone, W.C. , "Exploration of Sistema Huautla, Sistema Cheve, and Sistema J2 1976-2012," International TECHMEETING 2012, 14th Annual Technical Diving Conference, Bratislava, Slovakia, February 4, 2012.

2011

Stone, W.C. , "Экспедиция Алтайская Сугары 2011," (International Altai Expedition "Sugary" 2011), University of Texas, Austin, Texas, September 7, 2011.

Stone, W.C. , "Exploration of Sistema Cheve," Novosibirsk State University, Akademgorodok, Siberia , July 14, 2011.

Stone, W.C. , "Journey to the Center of the Earth... then Mining the Moon," Bohemian Club "Spring Jinks" Invited Lecture, Bohemian Grove, Santa Rosa, CA, June 4, 2011.

Stone, W.C. , "Expeditionary Cave Diving," Nerd Nite Austin, Austin, Texas, April 6, 2011. .

Stone, W.C. , "DEPTHX and ENDURANCE," IEEE Aerospace Conference, Big Sky, MT, March 7, 2011.

Stone, W.C. , "Human and Robotic Exploration of Earth and Space: Where we are now; Where we could be in 10 years," Jackson School of Geosciences, University of Texas at Austin, Austin, TX, February 23, 2011.

2010

Stone, W.C. , "ENDURANCE: (Environmentally non-Disturbing Under-ice Robotic ANtarctiC Explorer)," Geosciences Department Invited Lecture, Pennsylvania State University, University Park, PA, September 20, 2010.

Stone, W.C. , "Exploration of Sistema Cheve – J2, Oaxaca, Mexico," Geosciences Department, Pennsylvania State University, University Park, PA, September 20, 2010.

Stone, W.C. , "ENDURANCE: (Environmentally non-Disturbing Under-ice Robotic ANtarctiC Explorer)," NASA Glenn Research Center, Cleveland, OH, September 21, 2010.

Stone, W.C. , "Project VALKYRIE: (Very-deep Autonomous Laser-powered Kilowatt-class Yo-yoing Robotic Ice Explorer)," Proprietary Briefing, NASA Glenn Research Center, Cleveland, OH, September 21, 2010.

Stone, W.C. , "Human and Robotic Exploration of Earth and Space: Where we are now; Where we could be in 10 years," Microsoft Corporation, TechReady 2010 Conference, Seattle, WA, , March 24, 2010.

Stone, W.C. , "ENDURANCE: Two Missions to Antarctica and Paths to Advanced Sub-Glacial Science Autonomy," American Geophysical Union, Chapman Conference, Baltimore, MD, March 16, 2010.

2009

Stone, W.C. , "ENDURANCE Engineering – How the Bot Works 101," Public Lecture, Building 155, McMurdo Station, Antarctica, December 6, 2009.

Stone, W.C. , "Pushing the Limits of Robotic Sub-Ice Exploration," DASAN Conference, Seoul, South Korea, October 8, 2009.

Stone, W.C. , "Novel Options for Advanced Polar Sub-Ice Science Autonomous Mobility Platforms," National Science Foundation, Office of Polar Programs, Washington, DC, June 4, 2009.

Stone, W.C. , "Novel Sub-Ice Exploration of West Lake Bonney: ENDURANCE 2008 Mission," NASA, Science Mission Directorate, Washington, DC, January 21, 2009.

2008

Stone, W.C. , "Past and Planned Exploration at Sistema Cheve, Mexico," McMurdo Station, Antarctica, Public Lecture, Building 155, November 24, 2008.

Stone, W.C. , "Autonomous Exploration, Mapping, and Characterization of Channelized Karst Aquifers," Karst Waters Research Conference (KWI 2008), Rapid City, SD, June 10, 2008.

Stone, W.C. , "DEPTHX: A Fully Autonomous Free-Flying 4-degree-of-freedom Platform for Planetary Sub-Surface Aqueous Science and Exploration," Astrobiology Science Conference (AbSciCon 2008), Santa Clara, CA, April 17, 2008.

Stone, W.C. , "Fuel Moon: How can we Explore the Frontier Together," World Summit on Innovation and Entrepreneurship, Dubai, April 3, 2008.

Stone, W.C. , "ENDURANCE (Environmentally Non-Disturbing Under-ice Robotic Antarctic Explorer), University of Wisconsin School of Engineering Lecture, February 13, 2008, Madison, WI.

Stone, W.C. , "ENDURANCE (Environmentally Non-Disturbing Under-ice Robotic Antarctic Explorer), NASA Goddard Engineering Colloquium Lecture, January 28, 2008, Greenbelt, MD.

Stone, W.C. , "ENDURANCE (Environmentally Non-Disturbing Under-ice Robotic Antarctic Explorer), NIST Seminar, January 23, 2008, Gaithersburg, MD.

2007

Stone, W.C. , "ENDURANCE (Environmentally Non-Disturbing Under-ice Robotic Antarctic Explorer), University of Texas at Austin, Robotics Graduate Program Seminar, November 29, 2007, Austin, TX.

Stone, W.C. , "ENDURANCE (Environmentally Non-Disturbing Under-ice Robotic Antarctic Explorer), NOAA Science and Engineering Seminar, Silver Spring, MD, November 14, 2007

Stone, W.C. , "Mk VI Discovery: A True Recreational RB Unit," DEMA 2007, Las Vegas, NV, October 30, 2007.

Stone, W.C. , "DEPTHX: Deep Phreatic Thermal Explorer," Geological Society of America (GSA) Conference, Denver, CO, October 29, 2007.

Stone, W.C. , "Autonomous Exploration of the Sub-Surface Ocean of Europa… and the Search for Bugs Therein," Pace Symposium, University of Colorado, Boulder, October 28, 2007.

Stone, W.C. , "DEPTHX - ENDURANCE Summary," Oceaneering International, Houston, TX, September 17, 2007.

Stone, W.C. , "SpaceBrake: A Modular Deployable / Stowable Variable Lift Manuevering Orbital Lifeboat," NASA Headquarters Briefing, August 24, 2007.

Stone, W.C. , "ENDURANCE (Environmentally Non-Disturbing Under-ice Robotic Antarctic Explorer), Logistics Briefing, Raytheon Polar Systems, Denver, CO, July 17, 2007.

Stone, W.C. , "DEPTHX - ENDURANCE Summary," Oceaneering International, Houston, TX, September 17, 2007.

Stone, W.C. , "DEPTHX: Deep Phreatic Thermal Explorer – and the Sub-Surface Exploration of Europa," NASA Headquarters Briefing, June 14, 2007.

Stone, W.C. , "Pushing the Limits of Exploration on Earth and in Space," TED Conference 2007, Monterey, CA, March 10, 2007.

2006

Stone, W.C., "Autonomous Navigation, Homing, and Docking – Experience with the NASA DEPTHX Project", AUV MasterClass Conference, "Polar Sub-Ice Autonomous Underwater Vehicles", University of Southampton, England, March 27-30, 2006. Invited Keynote Lecture.

2005

Stone, W.C., "Autonomous Exploration of the Sub-Surface Ocean of Europa," The Explorers Club (Special Public Event), November 19, 2005, The Explorers Club, 46 E. 70th St., New York, NY 10021.

Stone, W.C., "Design of an Underwater Vehicle for Subterranean Exploration," UUST05, Conference on Un-manned, Un-tethered Submersable Technology, University of New Hampshire, Durham, NH, August 2005.

2004

"DEPTHX: Deep Phreatic Thermal Explorer. Pushing the envelope of robotic systems and silicon intelligence," NIST/BFRL Technical Seminar, August 5, Gaithersburg, MD.

“National LADAR Performance Metrics Facility Design,” SPIE Defense & Security Sensors Conference, Orlando, FL, April 12-14.

“DEPTHX: Deep Phreatic Thermal Explorer: System Architecture,” NASA ASTEP Conference, January 19-22, Boulder, CO.

2003

"Development of an Autonomous Intelligent Structural Steel Placement System," University of Texas at Austin 10-22-02

"Development of an Autonomous Intelligent Structural Steel Placement System," Carnegie-Mellon University 11-17-02

"Autonomous Steel Placement," Lecture for University of Maryland Intelligent Systems Seminar, February 5, 2003, Gaithersburg, MD.

"Opportunities in Construction Sensing and Automation," NAVFAC, May 21st, 2003 (at NIST)

"The State of the Art in Construction Metrology and their Data Exchange Problems," NIST Workshop on Jobsite Data Exchange 5-29/30 2003

"Construction Robotics: Myth or Reality," International Robots & Vision Show/International Symposium on Robotics, invited keynote lecture on Automation in Construction, Chicago, Ill, June 4, 2003

"LADAR@NIST: Basic Needs for a National Calibration Facility," NIST Workshop on LADAR Calibration June 12-13 2003.

"NIST Research in Construction Sensing and Automation," presentation to Disney Imagineering Research and Development representative, July 18, 2003, Gaithersburg, MD.

"Some Issues Relating to Performance Evaluation of LADARs," 2003 Performance Metrics Conference, NIST, Gaithersburg, MD. September 16-18, 2003.

"Tucker-Hasegawa Lecture," ISARC 2003 Invited Keynote Plenary Lecture, Eindhoven, the Netherlands, September 21-24, 2003.

2002

“Achieving General Construction Automation: Myth and Reality,” Carnegie-Mellon University, September 21, 2001.

“Achieving General Construction Automation: Myth and Reality,” University of Texas Civil Engineering Seminar, October 23, 2001.

“ NIST Construction Automation Program” Night Vision Lab, Fort Belvoir, December 17, 2001.

“NIST Construction Automation Program,” Irvine Sensors, Inc., January 24, 2002.

“NIST Construction Automation Program,” Riegl Systems, Inc., Horn, Austria, February 20, 2002.

“NIST Construction Automation Program,” CSEM, Zurich, Switzerland, February 20, 2002.

“NIST Construction Automation Program,” University of Siegen, Siegen, Germany, February 25, 2002.

"NIST Construction Automation Program," Briefing for Carnegie-Mellon University Research Initiative Team, March 12, 2002.

"Laser Radar Fundamentals," University of Texas at Austin, two lectures for the Sensors in Civil Engineering Course, March 21, 2002.

"Laser Radar Seminar Series," NIST, June 18-20, 2002.

"Towards the Ultimate Construction Site Sensor," ISARC, September 24, 2002.

2001

"Object Identification Using Bar Codes Based on LADAR Intensity," International Symposium on Automation and Robotics in Construction (ISARC-2001), Krakow, Poland, September 10-12, 2001.

"NIST Research in Smart Chips" CII-FIATECH Interested Parties Workshop, June 26-27, 2001, Gaithersburg, MD., June 26, 2001,

"NIST 3D Range Imaging Program," CII-FIATECH Interested Parties Workshop, June 26-27, 2001, Gaithersburg, MD., June 27, 2001

"NIST 3D Range Imaging Program," NIST Laboratory Director's Tour, June 22, 2001, NIST, Gaithersburg, MD.

"NIST 3D Range Imaging Program," Defense Advanced Research Projects Agency, June 21, 2001, DARPA, Arlington, VA.

"NIST Construction Automation Program," Federal Highway Administration (FHWA), June 14, 2001

"NIST Construction Automation Program," Office of Nuclear Energy, Science and Technology, Department of Energy (DOE), October 24, 2000

"NIST Construction Automation Program," National Aeronautics and Space Administration (NASA), December 18, 2000

"NIST Construction Automation Program," General Services Administration (GSA) December 14, 2000

William C. Stone: Computer Literacy:

Structural/Mechanical Analysis:

Package	Use	Skill Level
COSMOS/M	General non-linear/dynamic/vibration/thermal/CFD FEM analysis w/optimization, full 3D	Fluent (use daily)
COSMOS/Works	General purpose FEM tightly coupled to SolidWorks	Fluent (use daily)
STAAD-Pro	Production Structural Frame Analysis	intermediate
ANSYS	General non-linear/dynamic FEM	functional (used substantially in past years)
PATRAN	General non-linear/dynamic FEM	functional (used substantially in past years)
NASTRAN	General non-linear/dynamic FEM	functional (used substantially in past years)
DYNAMIC DESIGNER	Windows version of ADAMS (mechanical dynamics simulation) tightly coupled to SolidWorks	intermediate

Design

Package	Use	Skill Level
ACAD 14/2000/2004/2005	General CAD package 2D & 3D	Fluent (use daily)
SOLIDWORKS 2005	Parametric CAD package, 3D	Fluent (use daily)

Data Visualization

Package	Use	Skill Level
Walls3D	3D vector network analysis, statistics, and viz package	fluent
Maple	Symbolic Mathematics	intermediate
MATLAB	High level math and engineering program language	intermediate
SGI / GL	SGI-based graphics programming language (precursor to Open/GL)	functional (wrote extensively in past years)
IDL	General purpose data viz program	novice
Open/DX	General purpose data viz program	novice
MathCAD	General purpose symbolic math and viz program	novice

Image Processing & Illustration

Package	Use	Skill Level
Adobe Photoshop	manual image processing	fluent
Adobe Illustrator	commercial level graphics package	fluent
Adobe Premier	Commercial digital video editing	intermediate
MS Powerpoint	slide generator	fluent

DreamWeaver	web authoring tool	fluent
Corel	general drawing package	fluent

Software (programming)

Package	Use	Skill Level
MS Fortran 90	general scientific programming language	fluent
MS Visual Basic	general purpose GUI builder and coding language	intermediate
MS C++	general programming language	novice

Desktop Publishing & General Office/Report/Proposal Generation

Package	Use	Skill Level
QUARK EXPRESS	commercial desktop publishing program	fluent
MS Word	general word processing	fluent
EXCEL	general spreadsheet calculations	fluent
KALEIDAGRAPH	general spreadsheet calculations	fluent
Adobe Distiller	portable document generator	fluent
Adobe Acrobat	protable document reader	fluent
FAST TRACK	project management	fluent

Foreign Language Translation

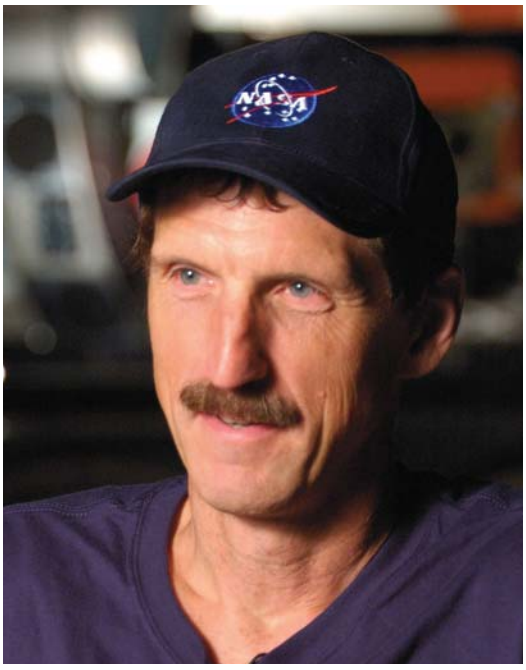
Package	Use	Skill Level
SYSTRAN	spanish document translation	fluent
MicroTAC	spanish document translation	fluent

Operating Systems

WINDOWS	most software	fluent
MAC	some graphics packages	fluent
UNIX	real-time and data viz programs	intermediate

Networking

Package	Use	Skill Level
Eudora Pro	email	fluent
CUTE-FTP	high speed file transfer	fluent
Netscape	web browser	fluent
Exceed 3D	X-windows emulator	intermediate



Bill Stone: What Others Say

"Engineer and daredevil explorer Bill Stone is obsessed with discovery. After years of crawling through the deepest unexplored caves on the planet, he's building robots to go where he can't. His company Stone Aerospace built DEPTHX, an autonomous robot, which explored 337 meters down into the world's deepest hydrothermal spring. In 2009, Stone and his team completed a successful 6-month mission to Antarctica. ENDURANCE, an expedition sponsored by NASA, was developed to explore and map under the ice of Lake Bonney in Antarctica. But this was just a test for the real mission: building a probe with NASA to bore through miles of ice on Jupiter's moon Europa, then swim through the buried Europan sea in search of alien life. He's also hoping to singlehandedly jump-start commercial human space exploration by offering spacefarers affordable fuels and consumables extracted from the moon. His new Shackleton Energy Company intends to raise $15 billion to mine ice thought to be trapped on the moon's southern pole at Shackleton Crater, and to sell derived products in low earth orbit (LEO) to international consumers. If all goes well, SEC will be open for business as early as 2020 as an international energy company" ***TED***

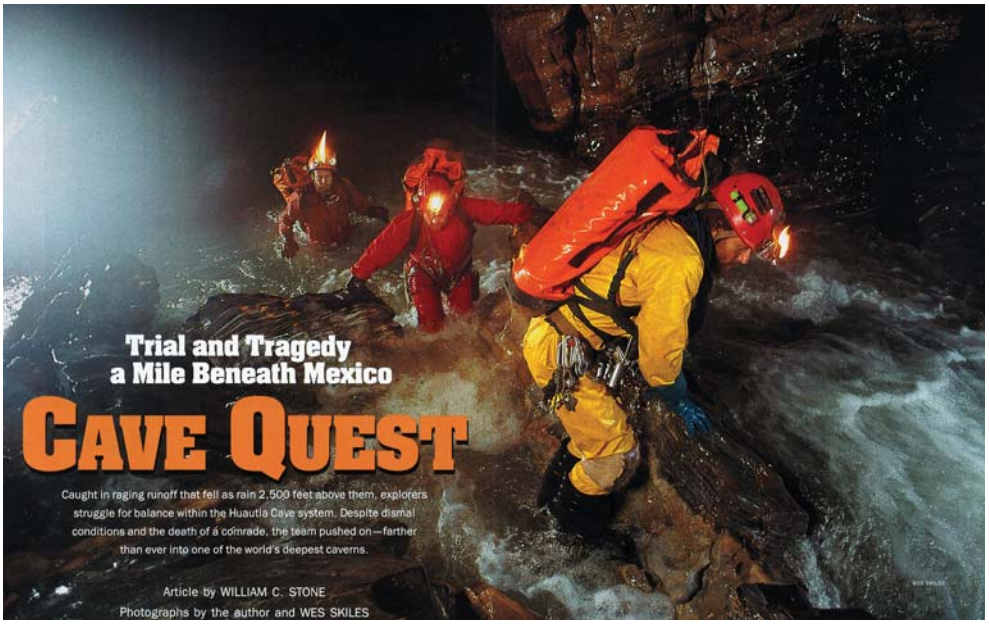
"With a doctorate in structural engineering and 11 patents to his credit, Stone is the archetypal modern-day explorer, a multidisciplinary maverick constantly inventing tools in the name of discovery lust" ***Wired Magazine***

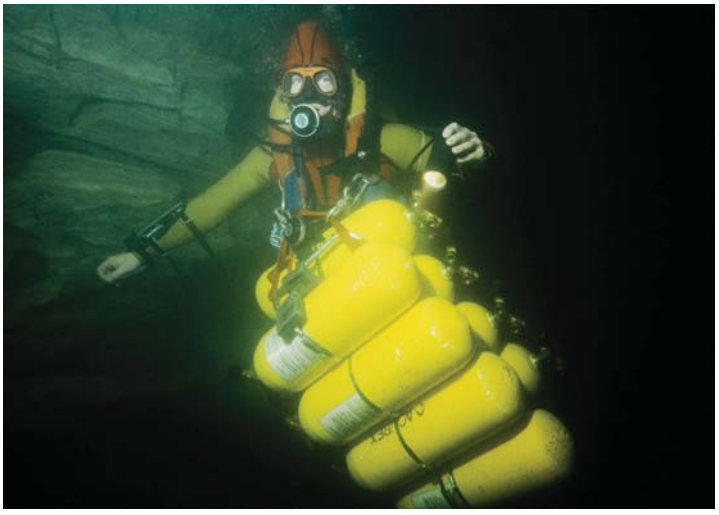
"Bill Stone is the world´s most famous expeditionary caver. Leading large international teams and backed by sponsors like the National Geographic Society, he has mounted more than 50 major expeditions to plumb the most hostile reaches of inner space. Spending weeks underground, his crews have traveled deep inside the planet to the remotest locations touched by humans. Nobody is better at what he does" ***Popular Science***

"Of the countless engineers who as children read the fictional adventures of Tom Swift and dreamed of becoming the fearless explorer-inventor, Stone is arguably the one who actually did it. Tall and lanky, with hawkish features and piercing blue eyes, he is probably best known for his exploits, chronicled in National Geographic and other magazines, in some of the world's deepest and most dangerous caves. Not uncommonly, those expeditions revolved around sophisticated technology of his own design and construction" ***IEEE Spectrum***

"Bill Stone is one of the world's foremost expeditionary cavers and proponent of using technology to help explorers survive and thrive as they challenge new frontiers. As a teenager, he determined to explore the world's deepest cave and by the time he reached his mid-twenties he had already co-led expeditions, explored, mapped and published about the deepest cave in the Western Hemisphere at that time – Sistema Huatla. As the founder of the US Deep Caving Team, Bill Stone also led the exploration and mapping of a seemingly endless underwater cave system beneath Florida's Wakulla Springs. An engineer by training, Stone is the president and CEO of Stone Aerospace. He has developed a highly advanced AUV, DEPTHX, to explore the world's deepest caves and is currently funded by NASA and The National Science Foundation to develop robots that will assist in the exploration of Antarctica and Jupiter's moon, Europa. In anticipation of advances of space exploration, he has launched the Shackleton Energy Company with a view to mining and processing water and rocket fuel on the moon for sale in earth orbit . A prolific author and inventor, Stone is a veteran of over 65 international expeditions." ***The Explorers Club***

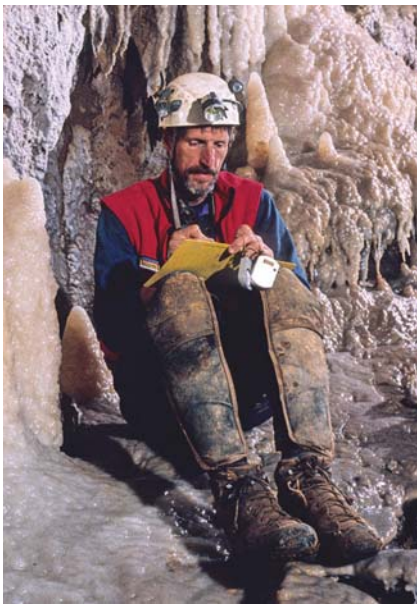
Bill Stone: Expeditionary Cave Exploration 1971 - 1994

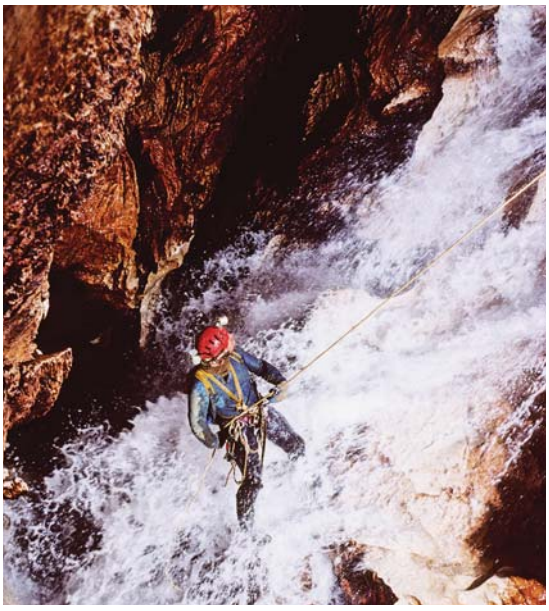




Bill has led or participated in 63 international expeditions in the last 40 years, spending more than eight years in foreign countries, mostly in southern Mexico, working in the extremely deep caves of the Sierra Mazateca (Sistema Huautla) and Sierra Juarez (Cueva Cheve) regions. In the pursuit of original exploration he has logged 514 days based from subterranean camps, many greater than a kilometer deep. The longest single stay was 19 days at Camp 4, -1209m deep in the J2 cave system in southern Mexico.

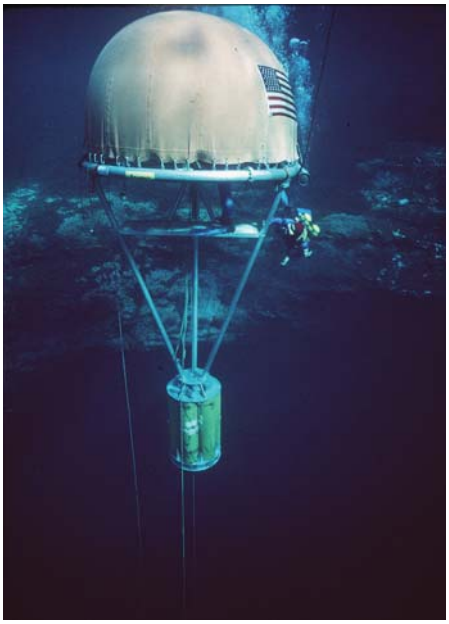
Bill Stone: Expeditionary Cave Exploration 1994 - 2014



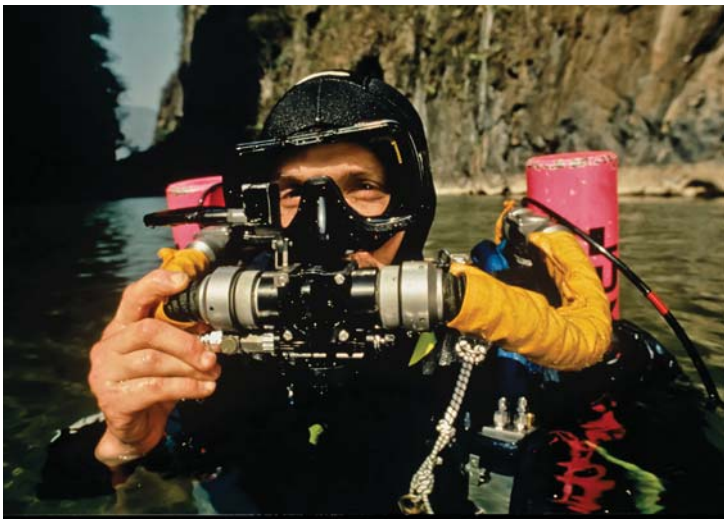


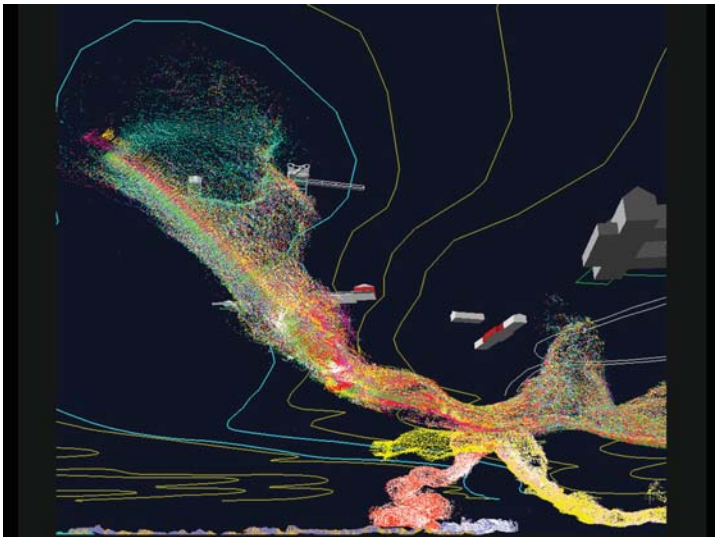
Bill is the principal architect behind the exploration of Mexico's Sistema Huautla (-1545m) and Sistema Cheve (-1484m). His work at Sistema Cheve led to the discovery of "J2", which ultimately reached a depth of -1229 meters at 11 kilometers distance from the entrance. Exploration at J2 culminated in a 3-1/2 month expedition involving 70 team members from 15 nations in Spring 2013. The team used the Poseidon Mk6 rebreather -- designed by Stone Aerospace -- as the primary life support system. The underwater tunnel at the limit of exploration in J2, known as "Sump 4", (at left) was successfully passed after 600 m of diving in 2013. The point reached beyond currently represents the most remote location reached inside the Earth by human exploration teams.

Bill Stone: Technical Diving Equipment Inventions



Bill holds 9 patents issued and 7 patents-pending for life support, underwater, and robotic systems. The 3-person underwater habitat (top left two images) was used for decompression at Wakulla Springs in 1987. Stone's companies (Cis-Lunar and Stone Aerospace) have designed 6 generations of rebreathers that triggered the "technical diving revolution" of the 1990s (the 4th generation Mk4 -- center left -- was used in Huautla in 1994). For Wakulla in 1999 Bill designed multiple underwater propulsion vehicles (middle right) with a range of 20 kilometers. The centerpiece of the 1999 project (lower left) was an inertially guided phased array 3D mapping system known as the Digital Wall Mapper. This was used in 1999 to create the world's first real-time 3D cave map at Wakulla Springs. A portion of the map near the spring entrance is shown at bottom right.

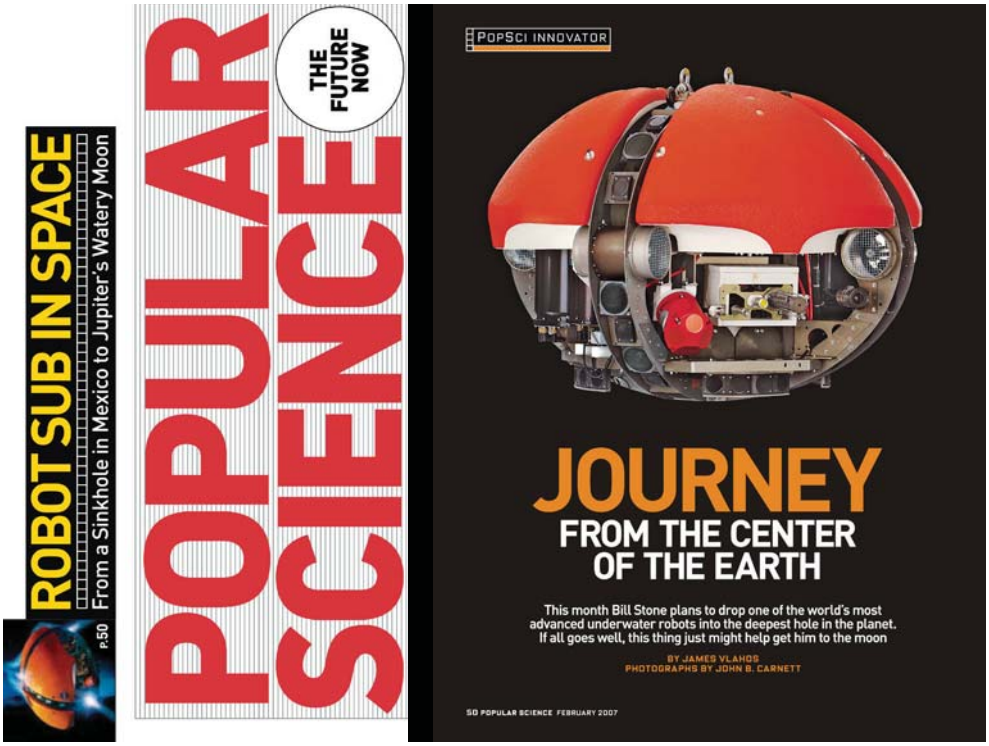




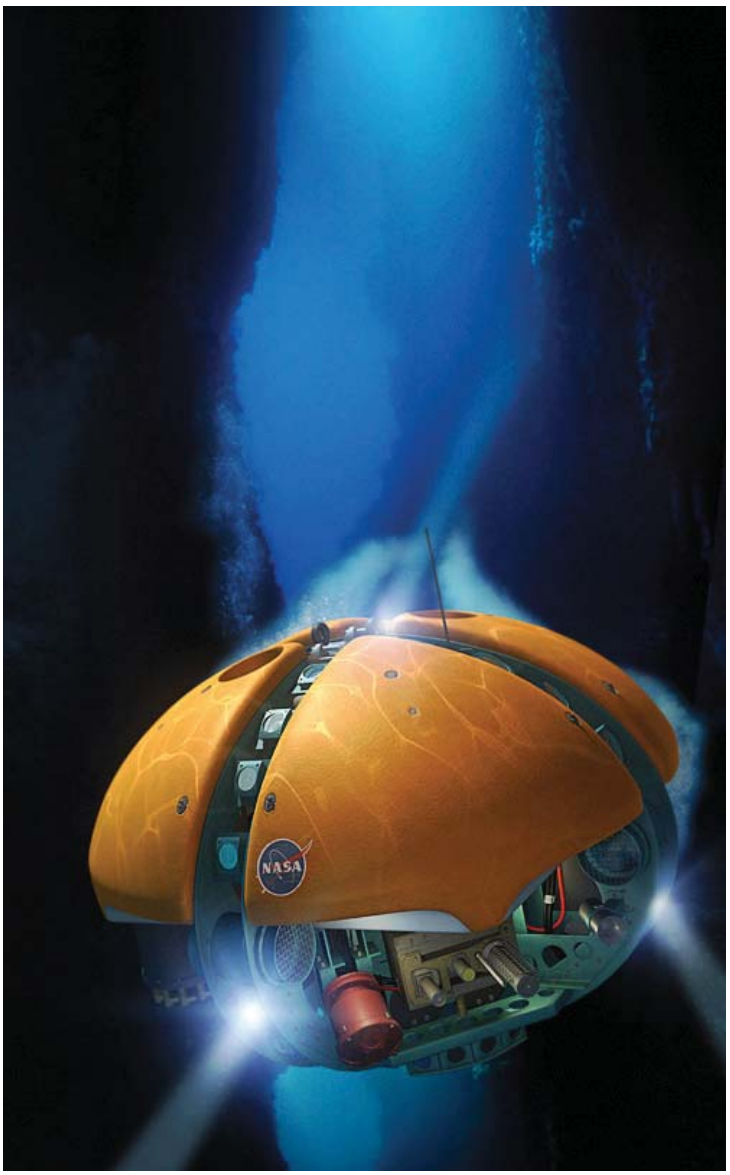
Bill Stone: The Exploration of Wakulla Springs, Florida

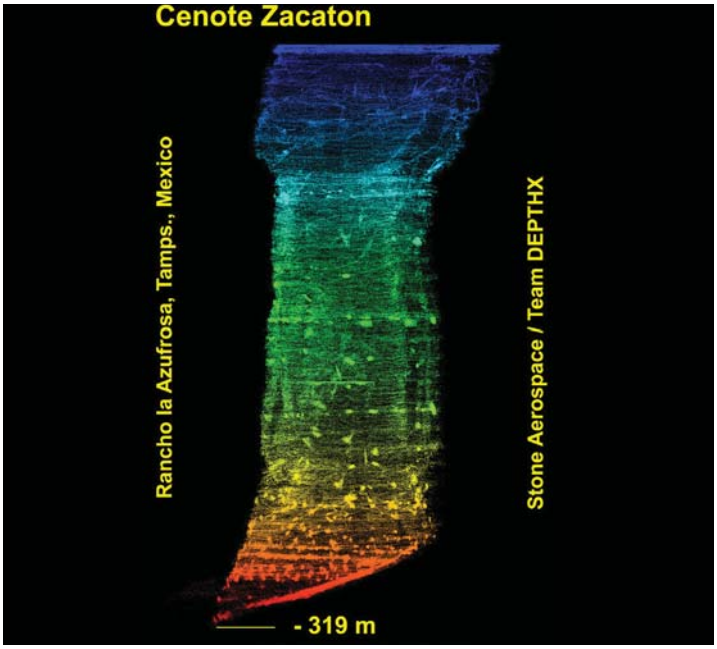
In 1999 Bill led the second National Geographic Society expedition to Wakulla Springs. This was the most technical cave diving expedition ever fielded and it resulted in the production of the world's first 3D cave map. The Cis-Lunar engineering design team (including Bill Stone, Nigel Jones and Mike Stevens) invented a series of devices including a 3D digital autonomous underwater imaging system; a dual version of the MK5 rebreather, which had a range of 20 hours at 100m depth underwater; the world's longest range diver propulsion vehicle (6-1/2 hour travel time at 1.2 meters/second); and a modular field-deployed floating hyperbaric decompression habitat and a mobile personnel transfer capsule that would retrieve returning exploration teams from –30m under pressure. The team developed custom decompression procedures to read MK5 diver information and generate the habitat portion of the surfacing schedule – something that had never been done before. The team conducted 32 deep level missions inside Wakulla Springs with average bottom times of 4.5 hours at 100m water depth. The expedition was the first to make routine scientific diving below –100m underwater. For several months the team fielded a significant mission each day. More than 23 kilometers of underwater tunnels were mapped in 3D. The resulting data include 10,000,000 survey points. This project was featured as the cover story in National Geographic Adventure magazine (Summer 1999) and as a documentary film on the National Geographic Explorer TV Channel (under the title "Mapping the Labyrinth"). A total of 234 MK5 rebreather dives were logged during the project.

Bill Stone: Project DEPTHX
PROTOTYPE FOR THE EUROPA MISSION HYDROBOT

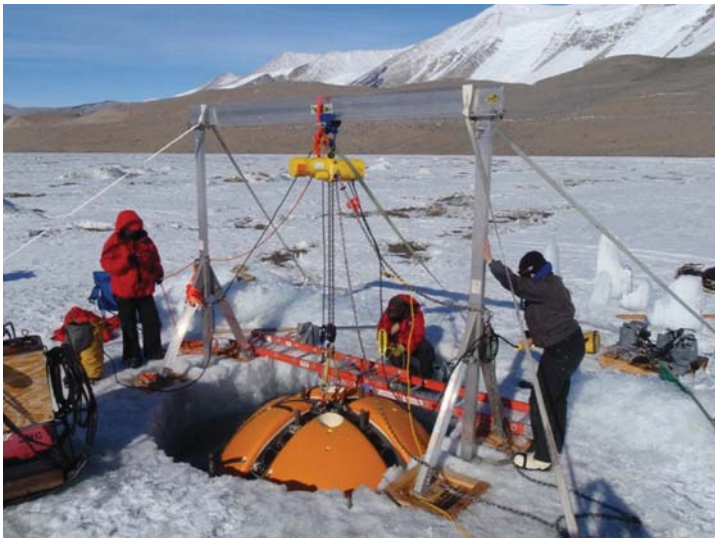


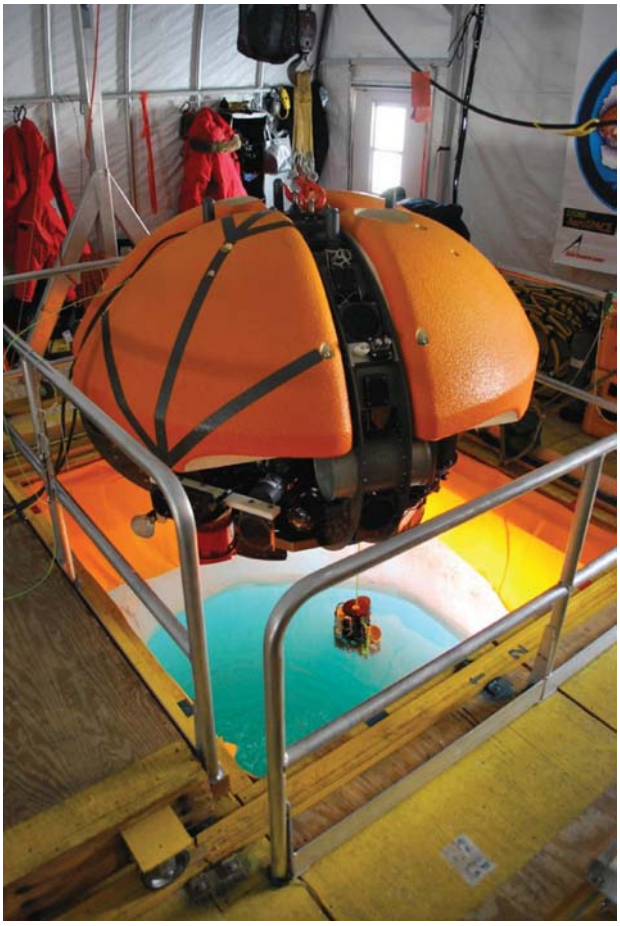
In 2003 NASA funded Stone Aerospace to develop a prototpye autonomous underwater vehicle to test novel navigation and microbial life detection and sample capture algorithms and systems. The resulting vehicle -- DEPTHX, or Deep Phreatic Thermal Explorer -- became the first robotic cave explorer. It autonomously explored and mapped the world's deepest hydrothermal spring (Cenote Zacaton - see bottom right profile map). On May 26, 2007, DEPTHX explored Zacaton where it discovered a chemocline (H_2S) at a depth of 114m. It autonomously followed the chemocline to a nearby wall, collected a core sample, and returned home. The rock samples returned resulted in the discovery of 4 new phyla of bacteria (at a time when less than 100 were known on Earth).



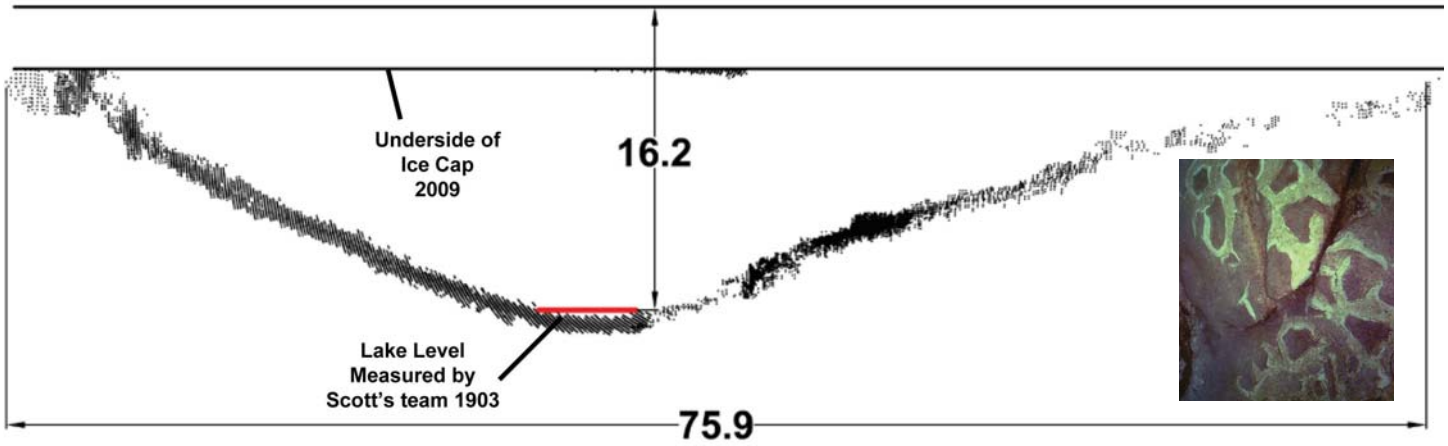


Bill Stone: Project ENDURANCE
PHASE 2 ANTARCTIC TESTING OF THE EUROPA MISSION HYDROBOT

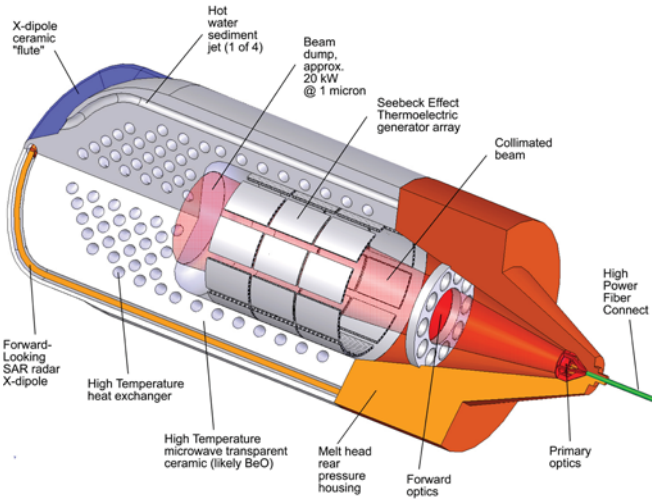


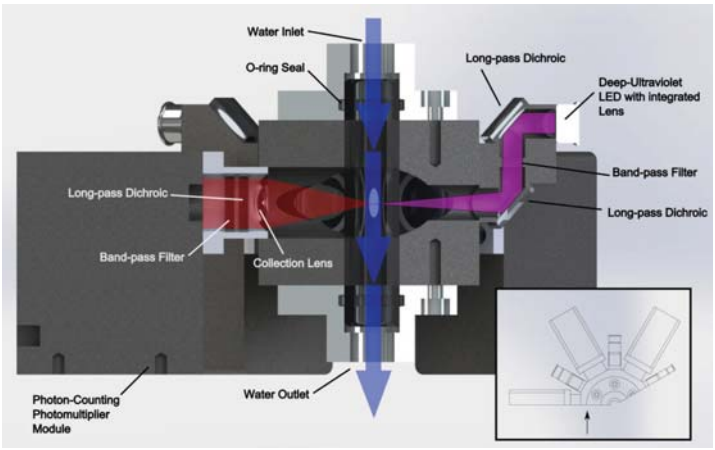


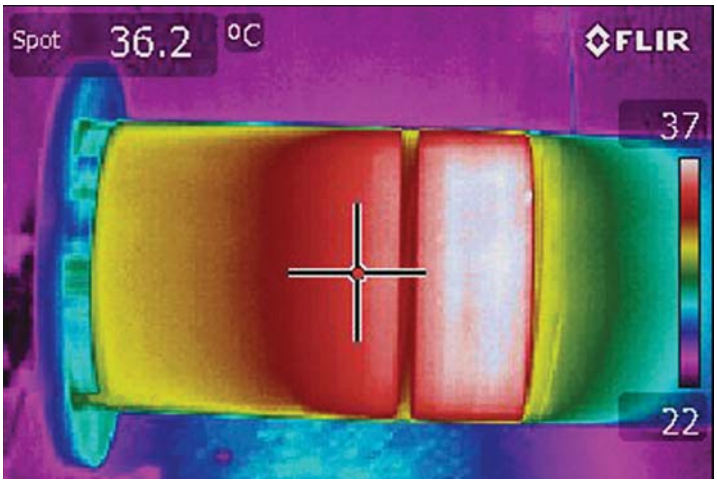
Bill was chief designer for NASA's ENDURANCE (Environmentally Non-Disturbing Under-ice Robotic ANtarctiC Explorer) robot. Designed for sub-ice autonomous navigation, exploration, and in-situ science, ENDURANCE was successfully fielded to Antarctica (3 months each during the Austral summers of 2008-9 and 2009-10) and produced complete 3D maps of permanently ice-covered, unexplored West Lake Bonney and complete 3D aqueous chemistry characterization of the lake. ENDURANCE makes possible the cataloging of vast sub-glacial areas used as sensors of global environmental change. The vehicle autonomously returned home to a 4m deep melt hole at the conclusion of each mission. Historically, ENDURANCE mapped areas seen first by Scott in 1903 (below). Due to rising lake level, the bot was able to fly where Scott walked. Microbial mats (lower right) were discovered near Blood Falls.

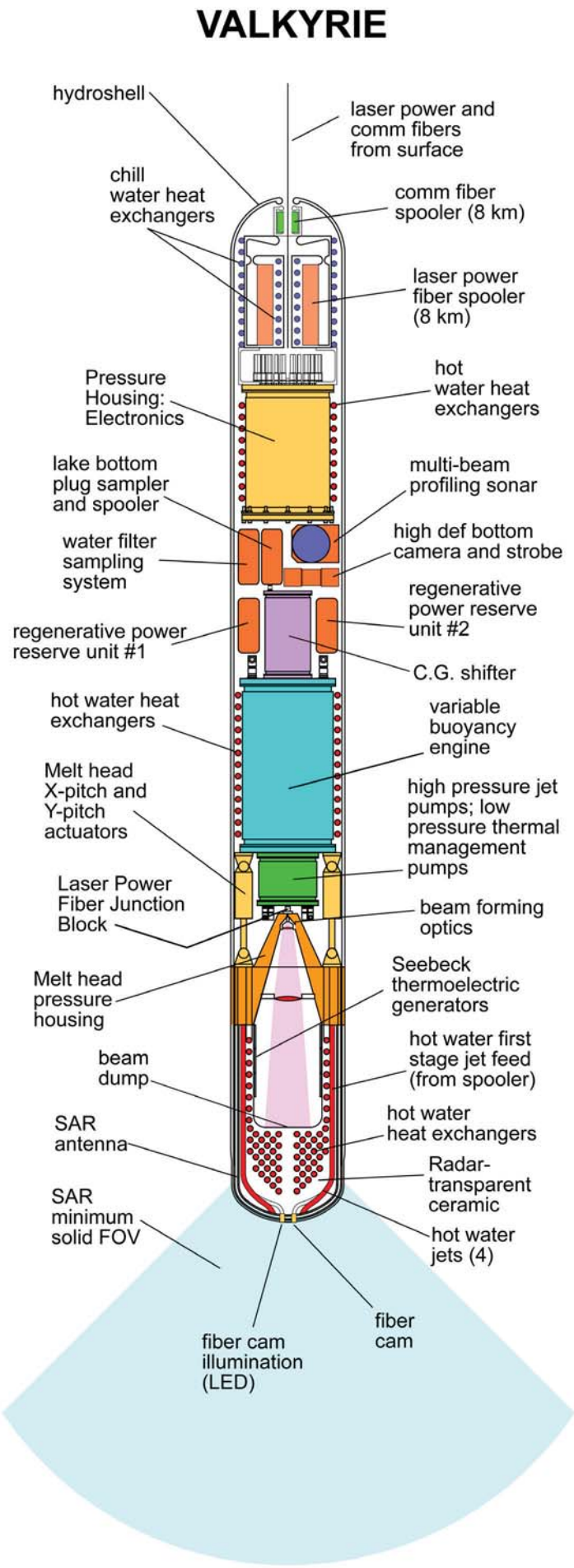


Bill Stone: VALKYRIE Laser-powered CRYOBOT Prototype

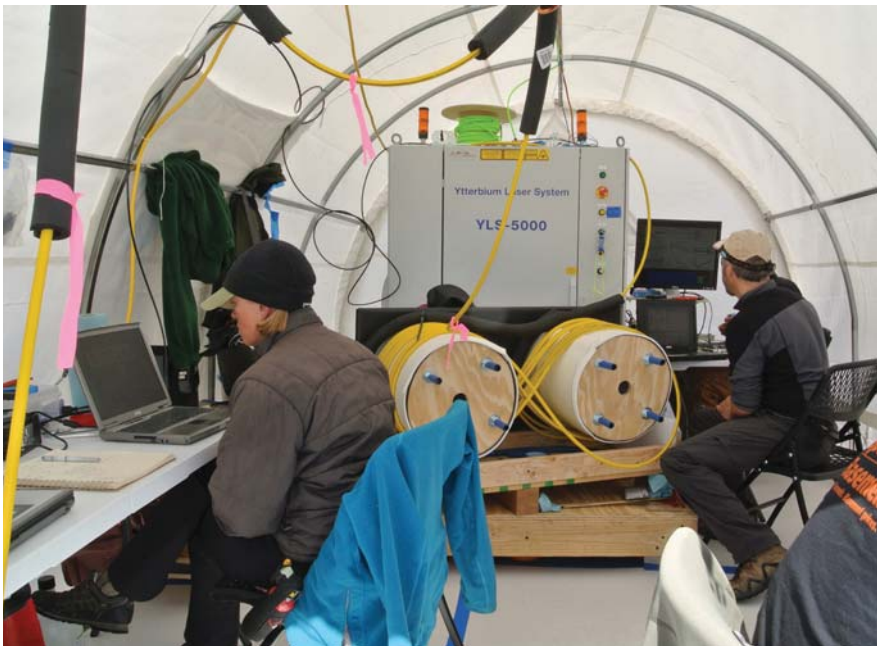








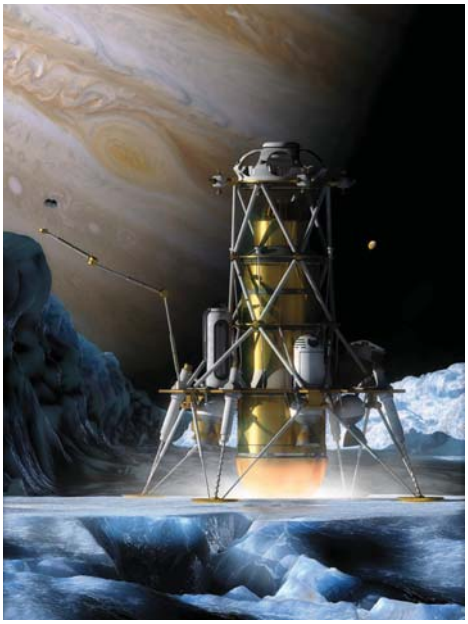
In 2007 Bill proposed a radical plan for a non-nuclear full scale CRYOBOT that could penetrate 3 kilometers below South Pole station, sample microbes from the sub-glacial lake located below the station, and return them to the surface. The concept -- now funded by NASA in Phase 2 as project VALKYRIE -- uses ultra high power lasers beamed down an optical wave guide deployed by the bot. A “beam dump” (upper left) convertes the photon power to electrical power for operating onboard systems. Deep ultraviolet sensors autonomously detect microbes of interest (center left) while the bot releases power fiber from an onboard 8 kilometer spooler (bottom left). The entire vehicle (at right) is an incredibly complex device in a simple tubular housing. It uses synthetic aperture radar to look ahead and avoid obstacles in the ice.

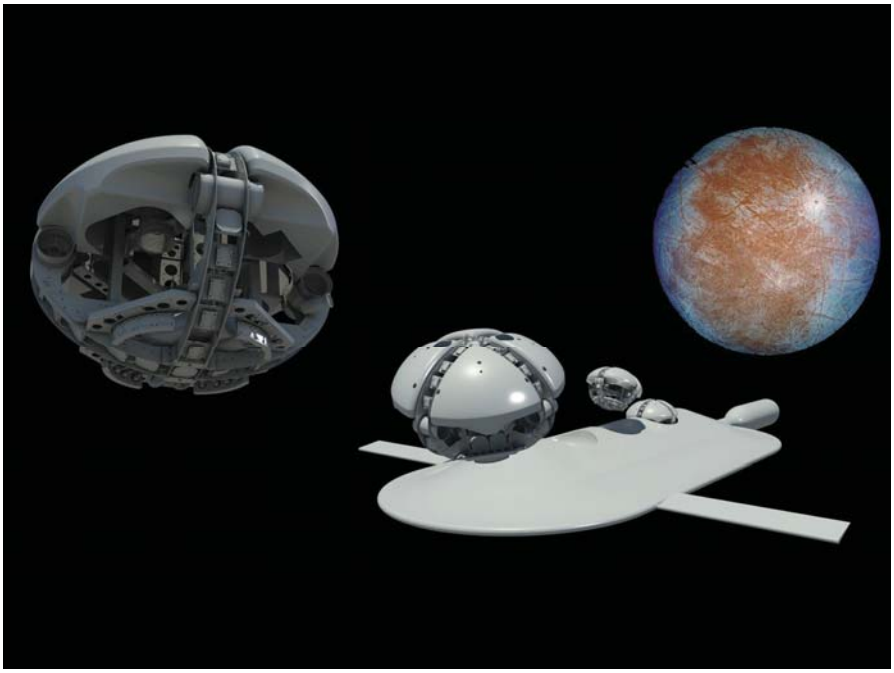


VALKYRIE IMPACT

On June 16, 2014 Team VALKYRIE (Very deep Autonomous Laser-powered Kilowatt-class Yo-yoing Robotic Ice Explorer) achieved an extraordinary feat: it used the photons generated by a 5,000 watt laser, sent down a 25 micron pure silica fiber, to power an ice-penetrating robot. The vehicle descended to a depth of 15.2 meters into the Matanuska glacier in Alaska and was successfully recovered. Six days later the robot descended to 30.52 meters, marking the deepest ice penetration ever achieved by a cryobot. More importantly, the physics principles utilized in VALKYRIE's design enable operation of the vehicle to extraordinary distances, with penetrations into any of Antarctica's sub-glacial lakes now becoming feasible with pre-sterilized robotic systems capable of not only accessing such lakes, but of exploring them to great distances from the point of entry. Significant amounts of power can be transferred using the VALKYRIE technology to points more than 40 kilometers from a point of entry, either within ice caps or undersea, with the potential of extension to as much as 100 kilometers. The successful field test of VALKYRIE represents the emergence of a disruptive technology in which autonomous agents, now free of battery-life constraints, may perform persistent science at locations previously inaccessible.

Bill Stone: Vision for FULL EUROPA LANDER MISSION





In 2010 Bill worked with National Geographic Television to bring to life the Europa Mission in CG animation (in the film titled “Journey to an Alien Moon”). The above images, using Stone Aerospace vehicle designs, show the stages: landing (upper left); cryobot melting through Europan ice cap (top center); avoiding embedded asteroidal debris (top right); breakthrough into the Europan ocean (center left) with deployment of the ARTEMIS “fast mover” mother ship and (center right) deployment of ENDURANCE-derived marsupial “sub-bots” to investigate dangerous places likely to harbor life. The long range ARTEMIS vehicle was just approved by NASA and NSF for 2014 deployment to Antarctica. It will become the first autonomous system to penetrate under the Ross Ice Shelf. Major discoveries in both macro and microbial lifeforms are anticipated, given the completely unexplored nature of this 360,000 square kilometer unknown area on Earth.