Arizona Geological Society Newsletter

APRIL 2018

April 3rd, 2018 DINNER MEETING

Who: **Volker Spieth and Stanley B. Keith** are the featured speakers. See abstract below.

Where: Sheraton Tucson Hotel and Suites, 5151 East Grant Road, (at the intersection of Grant and Rosemont on the North side of Grant in the **SABINO BALLROOM** (enter at northwest corner of the building) and go upstairs to the meeting room.

When: Cash Bar at 6 p.m.—Dinner at 7 p.m.—Talk at 8 p.m.

Cost: Members $30, Guests $33, Students Members free with online reservation ($10 without).

RESERVATIONS ARE REQUIRED: Reserve on the AGS website (http://www.arizonageologicalsoc.org/events) by 11 am on Friday, March 30th. Please indicate Regular (Top Sirloin with Mushroom & Au Jus), Vegetarian (Roasted Vegetable Tower) or Salad (Chicken Caesar Salad) meal preference. Please cancel by **Friday, March 30th at 11 am** if you are unable to attend - no shows and late cancellations will be invoiced.

The April dinner meeting is sponsored by

If you are interested in sponsoring a dinner meeting, please email:
vpmarketing@arizonageologicalsoc.org

ABSTRACT

Finding Gold in the Kupferschiefer

By Volker Spieth and Stanley B. Keith

Finding gold in the Kupferschiefer is exciting for the economist who gains a considerable improvement in the profitability of the mine, but in the case of the Kupferschiefer it is primarily a paradigm change. For a long time the miners recovered precious metals, that is gold, silver, platinum, palladium from the Kupferschiefer ore pyrometallurgical smelters. However, the scientists largely disregarded this matter until recently. This is changing, with consequences.

Some of the new research results in summary:

- Much of the Kupferschiefer is an amorphous siliceous-calcareous, hydrocarbon, metal rich mud
  - Hot hydrothermal brines transported the mud and the metals from deep reaching faults
    - The polymetallic and precious metals and hydrocarbons are high temperature
      - Gold and silver are primary constituents of the copper mineralization

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- The depositional environment is open seeps of hydrothermal brines on a shallow sea floor
- The Weissliegend sands are part of the extrusive hydrothermal system and are ejectites
- The Weissliegend carries primary rich copper mineralization
- The vast majority of the Kupferschiefer economic resources are located in the Weissliegend ejectites
- Existing exploration and mining activities are confirming this new resource model

The Permian Kupferschiefer sea covered an area of more than 600,000 sqkm. from today's east Greenland to central Europe: Germany and Poland. The strata of the sea is expressed by a thin black shale layer covering Rotliegend sandy and conglomeratic sediments and is covered by younger limestones. It is very barren of lifeforms and is not metamorphosed. Kupferschiefer has been identified by Agricola in his monumental book from 1556 and has been described since the mid-1800s in hundreds if not thousands of research papers. On the southern end of the Kupferschiefer sea area the so called European Copper Belt extends over more than 1,000 km west to east where the Kupferschiefer associated metals are being mined at a volume of about 500,000 tons of Cu metal per annum. The origin of the Kupferschiefer black shale sediments has long been believed to be the bottom accumulation of an euxinic sea with aspects of red-bed mineralization. Which may be true in part for the vast shallow hostile sea in the era of the Permian extinction.

At the southern margin of the sea – not close to the coastline – extends the European Copper Belt. Here, the copper rich mineralization occurs in the underlying Weissliegend sandstone, is sequentially layered with polymetallic, copper and precious metal rich mineralization in the Kupferschiefer black shale and extends upwards in the hanging wall dolostone. It is in the Kupferschiefer, however, where high temperature copper minerals like digenite and bornite and chalcocite carry disseminated and partly exsolved gold (Electrum) and other precious metals in a matrix of hydrocarbon rich chemical mud. This mineralization is of deep hot hydrothermal origin with many aspects related to very deep sourced mantle brines extruding "black-smoker-like" into the shallow Permian sea in a failed rifting tectonic environment.

This paradigm change from low temperature synsedimentary and/or red-bed-type deposition to hot hydrothermal active intrusive-extrusive chemical brine mud volcanism makes a great difference for the scientific explorer: Whereas before there was no exploration technique available except wildcat drilling, now a model has been developed that recognizes the tectonic and intrusive-extrusive hydrothermal-post-volcanic environment and is able to pinpoint metal rich targets of considerable grade and tonnage, particularly contained in the footwall Weissliegend sandstone, a model exemplified by the Spremberg discovery in Germany and the Rudna mine in Poland. Additional information about the Kupfershiefer can be found at Kupferschiefer Myths Debunked by Stanley B. Keith, Jan C. Rasmussen, and Volker Spieth.

THANK YOU!

The following AGS members recently made generous contributions to AGS:

Richard Jones—M. Lee Allison Scholarship Fund

David Briggs—Greatest Needs Fund

Eric Seedorf—Courtright and M. Lee Allison Scholarships

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ABOUT THE SPEAKERS

Volker Spieth

Volker Spieth earned his B.Sc. in Tuebingen, Germany, working on moon rocks and the newly discovered Ries meteor crater. He earned his M.Sc. in ore deposit mineralogy in Aachen, Germany, for work on base metal deposits in Iran. As exploration geologist and manager for AMAX and St. Joe Minerals he gained the leadership experience in natural resource development. With his own junior mining company GWB based in Hannover, Germany, he explored, discovered and developed world wide, for corporate clients and private investors. In this role he discovered gold, base metal and industrial minerals deposits, and brought them to development and production in more than 50 countries, from Greenland to Mongolia, from Bolivia to Siberia, with the last successful project being the Spremberg Kupferschiefer Cu-Ag-Au deposit in Germany. He published scientific papers and is currently finishing his research work at the University Stuttgart, Germany, as PH.D. candidate.

Stanley B. Keith

Stanley B. Keith has over 40 years of exploration experience focusing on ideas, exploration, and discovery of mineral and energy resources. His hands-on knowledge and extensive international experience include nearly all mineral deposit types and geologic settings. Stan began as a field and research geologist with the Arizona Geological Survey in the late-1970s, when he recognized an empirical relationship between mineral deposits and their associated igneous rocks. Exxon Research funded a project to research this concept as applied to the southwestern United States. In 1983, Stan co-founded MagmaChem Exploration Inc. and directed the development of the Magma-Metal Series Classification while working on numerous exploration and research projects for both mineral and energy exploration companies. Stan is a prolific writer and speaker and has co-authored hundreds of technical reports and publications. His marathon, 3-day, magma-metal series workshops and field trips have been presented to major companies in the mineral industry and the oil and gas industry. Beginning in 2000, Stan and colleagues began applying the MagmaChem model to oil and gas, which led to the concept of the serpentosphere (at the Moho), the hydrothermal origin of kerogen, and a reconsideration of the origin of the Kupferschiefer deposits as results of mud volcanoes. Throughout his career, Stan continually returns to the reality of the field, testing ideas through geologic mapping. Stan is a University of Arizona alumnus and received a B.S. degree in Philosophy in 1971 and an M.S. degree in Geology in 1975.

Arizona Geological Society Membership Stats (3/27/2018)

Total Membership	Professional Members	Student Members	Organizational Members
439	351	81	7

AGS Executive Committee Members Needed!

Are you interested in the future of the **Arizona Geological Society (AGS)**? Would you like to make a meaningful contribution to the geology profession in Arizona? If so, the AGS needs you! The **Arizona Geological Society Executive Committee** is currently looking for volunteers – professional geologists and students – to serve in these four open committee positions:

- **Vice Treasurer**
- **Vice Secretary**
- **Councilor**
- **Councilor**

The Executive Committee meets **once a month from 6 pm to 7:30 pm**. Your small commitment of time each month can make a huge difference for the AGS. If you are interested in one of these volunteer positions and would like more information, please contact the Arizona Geological Society by email at:

info@arizonageologicalsoc.org

Arizona Geological Society is awarding Lifetime Membership to these three outstanding individuals!

James Briscoe

James Briscoe has a BS and MS in Geology from the University of Arizona. He is a Registered Professional Geologist in the States of California and Arizona since 1969 and 1972 respectively. James is one of the founders of Liberty Star Uranium & Metals Corp. He has been involved in mineral exploration and discoveries for the past 50 years. He is credited with expanding porphyry copper ore reserves at Silver Bell, Arizona and identifying major gold deposits in the Randsburg District in California. He also aided in the discovery of the McDermitt open-pit mercury mine in Nevada. Mr. Briscoe co-discovered and co-owned the Wind Mountain gold-silver mine in Nevada. In Alaska, he identified the Big Chunk caldera and the copper-gold-moly potential continuation from the Pebble mine and alteration zone. James Briscoe also identified the Tombstone Caldera in 1988. He has served as either an officer and or director of three other publicly trading exploration and development companies.

Ted Eyde

Ted Eyde is an Engineering Geologist for Pedregosa Basin Resources LLC. He also owns the Gadsden Sonora Holdings Company LLC with his wife. Ted grew up in Butte, Montana, where he received an MS in Geological Engineering from Montana Tech. Afterwards, he worked for the Union Carbide Corporation on specialty and performance industrial minerals. Ted moved to Arizona in 1959 to assist the company with locating natural zeolite deposits. He eventually discovered a large cabazite deposit, which is still being used today. He was the president of the Society for Mining, Metallurgy & Exploration (SME) national chapter in 1991. He is also the cofounder of the Mining Foundation of the Southwest. The Foundation promotes public understanding and education related to mineral resources and the mining industry, and funds educational projects each year in the southwest and Mexico.

Peter Kirwin

Peter Kirwin received his BA in Geology at Dartmouth College in 1957, and his MS in Geology and Geophysics at the University of Minnesota in 1963. He started his career in Tucson in the summer of 1960, following two summers in the Canadian bush. He lived in Arizona towns such as Tucson, Wickenburg, Kingman, and Cottonwood. He worked for 40 years in metals exploration in ten U.S. states, 3 Canadian provinces, all Australian states but Tasmania, Sinaloa, and New Guinea. He worked for many companies, including Kennecott (BCMC), NJ Standard (Exxon/Humble), Inco, Cyprus, Copper Range, Lac, and Siskon, in management positions up to district manager and U.S. exploration manager prospecting for various deposits (copper, molybdenum, gold, poly metallic, etc.). His last consulting job in Arizona was in the Globe-Miami District for Cyprus Mines, which led to a new recognition of the structural setting and mode of emplacement of the Miami-Inspiration deposits.

AGS By-Laws Change Effective March 6th, 2018

Effective March 6, 2018, the AGS membership has voted to change Article IX, paragraph 2(d) of the AGS By-laws from:

(d) 50-Year Members – members in good standing who have maintained continuous membership for a minimum of 50 years shall have the privileges of a full member of the Society and will be excused from further payment of dues.

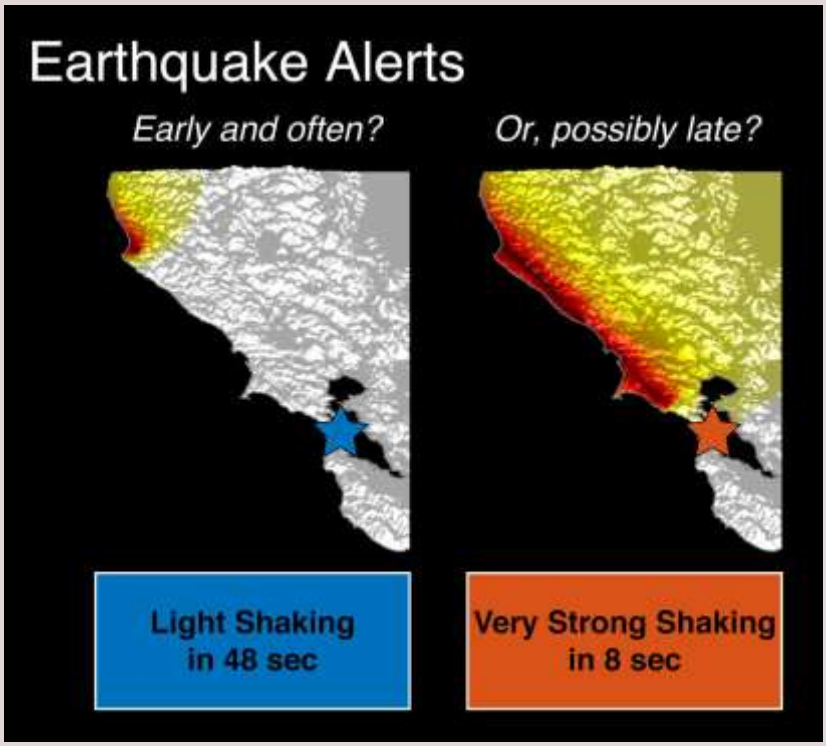
to:

(d) 50-Year Members – members in good standing who have maintained membership for a minimum of 50 years shall have the privileges of a full member of the Society and will be excused from further payment of dues.

Please contact the AGS Secretary if your company is interested in advertising in this monthly newsletter.

Early Earthquake Warning! New Study Examines Safety Potentials and Limits

by U.S. Geological Survey, March 27th, 2018



The choice when issuing earthquake warnings is to: 1) issue alerts for weak shaking and potentially provide long warning times, but risk sending alerts for the many events that do not go on to produce damaging ground shaking, or 2) issue alerts only when ground shaking is expected to be damaging, with the tradeoff that the alert will be sent much later, reducing the amount of time available to take action. (Public domain.)

In a newly published study, U.S. Geological Survey scientists and their partners calculate possible alert times that earthquake early warning systems can provide people at different levels of ground motion from light to very strong shaking.

Results of scientific studies such as this can be used to design alerting strategies for earthquake early warning systems such as USGS' ShakeAlert, now being developed for the U.S. West Coast.

This new study examines what the expected warning times could be for earthquake early warning systems by considering how long it takes an earthquake to grow in size (magnitude) compared to how long it takes earthquake waves (shaking) to arrive at a user's location.

Modern earthquake early warning systems can monitor the evolving rupture, issuing alerts to regions expected to experience a certain level of shaking as the earthquake is occurring. If the earthquake rupture grows, and the region impacted by ground motion expands, alerts may be updated and extended to new locations. A person will experience very strong ground motions only if the earthquake grows to a large-enough magnitude and if the fault rupture breaks close to their location.

"Small and large earthquakes begin in similar ways, so we can't know just after an earthquake starts how large it will ultimately become," said Annemarie Baltay, a USGS seismologist and coauthor of the report.

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Consequently, earthquake early warning systems have the greatest potential benefit for people who can take protective action when warnings are issued for low levels of ground shaking. If alerts are only issued for very strong shaking, people will have less time to respond and take action.

When and if an advance warning is issued thus depends critically on the ground motion threshold set for alert notification. The time available to issue an alert depends on both a user's distance to the rupturing fault and the minimum level of ground motion for which the user wants to be alerted. The amount of warning time depends most strongly on the ground-motion level that is used to trigger alerts. Longer warning times are possible if alerts are issued at lower thresholds, when only weak ground motion is expected from the earthquake.

"Using the example of an earthquake on the San Andreas Fault, that starts in northern California and ruptures toward San Francisco, alerts issued when just light shaking is expected in San Francisco could provide warning times as long as about 48 seconds in advance of when the earthquake shaking is felt there," said Elizabeth Cochran, a USGS seismologist and coauthor of the report. "In contrast, if you wait to alert San Francisco until very strong shaking is anticipated, only 8 seconds of warning are possible."

The authors noted that if users are willing to receive alerts and take safety actions even when it is unlikely the ground shaking will grow to become damaging, they are more likely to receive timely information they can act on. In contrast, if users prefer to limit alerts to events during which ground motion is expected to be very strong, then warning times will be short, or perhaps even arrive too late to act.

"The conundrum," noted USGS seismologist and lead study author Sarah Minson, "is that little earthquakes are much more common than big ones. You could get much longer advance warning if you take action to protect yourself as soon as an earthquake begins and not wait to see if that earthquake happens to grow large enough to cause potentially damaging shaking."

Alerts for weak shaking could help provide effective response training for when a bigger, damaging earthquake eventually occurs. "There are many low-cost actions that can be taken even when scientists can't forecast the final strength of an earthquake. This includes drop-cover-hold-on; slowing down trains to prevent high-speed derailments; putting down hazardous work materials, such as chemicals or saws; backing away from warehouse racks and other fragile structures in 'big box' stores; and so on," said Men-Andrin Meier, a Caltech seismologist and coauthor of the report.

The full report, "The Limits of Earthquake Early Warning: Timeliness of Ground Motion Estimates," was published in "Science Advances," and is available online here:

http://advances.sciencemag.org/content/4/3/eaaq0504.full

Information about the U.S. Geological Survey's earthquake early warning system Shake Alert is available online here:

https://www.shakealert.org/

~~Welcome New Members~~

Kevin Hubbard Luth Samana Daabid Schellenberg Alberto Silva Ariano

James Davis David Reid Chris Wanless Russ Franklin

Joan Barry Wayne Edgin Seymour Sears Matthew Wetzel

Arizona Geological Society is grateful to Freeport-McMoRan, Inc. for their generous support of our student members! Freeport-McMoRan sponsored student dinners for the 2018 AGS monthly meetings.

FREEPORT-MCMORAN

AGS MEMBERSHIP APPLICATION OR RENEWAL FORM

YOU CAN RENEW OR SIGN UP as a new member and pay online. Please go to our website, arizonageological-soc.org. Or use the form below if you are more comfortable with the old school approach.

Please mail check with membership form to: Arizona Geological Society, PO Box 40952, Tucson, AZ 85717

Dues (check box) ☐ 1 year: $35; ☐ full-time student (membership is free)

NEW MEMBER or RENEWAL? (circle one) Date of submittal _____

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All newsletters will be sent by email. If you do not have an email address, we will mail a hard copy to you, but we cannot guarantee timeliness.

If registered geologist/engineer, indicate registration number and State: _____

Enclosed is a _____ tax-deductible contribution to the ☐ J. Harold Courtright or the ☐ M. Lee Allison