



COLD WAR HOT NUKES

Legacy of an Era

It was a dramatic day in the history of radioactive contamination in the former Soviet Union. On 15 December 2000, a Ukrainian engineer flipped a switch at Chornobyl (formerly Chernobyl), and the infamous nuclear power plant—or rather, what was left after the 1986 explosion that sent eight tons of airborne radioactive particles across the region and into nearby countries—was finally shut down. After long resisting the closure because of the need for the energy produced by the plant's remaining reactor, Ukrainian president Leonid Kuchma proclaimed that “the world will [now] become a safer place” and “people will live in peace.”

In Ukraine alone, millions of people have been affected by the accident at Chornobyl. Thirty-two people, mostly firefighters, were killed almost immediately, and at least 4,000 cleanup workers have since died from radiation-induced ailments including cancer. Three million children are still seeking treatment for Chornobyl-related ailments, according to a 15 December 2000 Associated Press article. People who live near the plant in northern Ukraine and across the border in Belarus have seen a significant increase in the incidence of thyroid cancer, especially in children born later to exposed parents. The widespread fallout also temporarily devastated eastern and northern Europe's agricultural sector. Soviet authorities did not reveal the Chornobyl accident until Swedish scientists detected airborne radioactive particles in Sweden and determined that Ukraine was the source.

The question of how to clean up radioactive dust and nuclear fuel inside Chornobyl's damaged reactor has yet to be answered. And Chornobyl is just one of the many nuclear-related hazards that continue to threaten the environmental health of the former Soviet states and their neighbors. Many factors contribute to this ongoing risk, including policies that emphasize production over safety, aging facilities, poor maintenance, outdated technology, and a lack of skilled operators or the money to pay them. Much of the former Soviet Union is struggling to cope with a



A lesson in reality. The legacy of the 1986 explosion at the Chornobyl Nuclear Power Plant lives on in millions of affected lives and deserted towns such as nearby Prypyat (left and center, Chornobyl then and today; right, Prypyat).



Dead cities. Closed “nuclear cities” such as Krasnoyarsk-26 (left, in an underground facility; above, from outside) are home to some of the worst nuclear contamination in Russia. For decades, nuclear waste from Mayak was dumped directly in the Techa River (far right), a primary water source for many villages downstream. Most of these villages were evacuated, but 4,000 people remain today in Muslyumovo (near right).

nuclear power and weapons legacy widely viewed as the product of government policies that disregarded human and environmental health for decades.

“Throughout the history of the Soviet Union we experimented with nuclear power and bombs quite a bit,” says Vladimir Slivyak, cochairman of Ecodefense, an environmental organization located in Kaliningrad, Russia. “Moreover, the state system was not economically oriented, which made the nuclear and defense industries feel a lack of responsibility. Neither industry cared about human health or the environment; they didn’t have to pay for the damage. And because it was one of the largest countries in the world, it also has the largest contamination in the world.” Slivyak says the situation has actually worsened since 1991, because most of the dangerous facilities are still in operation, releasing radioactive substances into the environment in larger amounts than ever before. “The reason for this is simple,” he says. “The facilities are old and in bad technical condition.”

Russia is generally ranked as the most radioactively contaminated country in the world, from the Barents Sea on its north-west border to the Pacific Ocean far to the east. Its former republics are also contaminated but to a lesser degree. To the south, Kazakhstan has just closed down a former

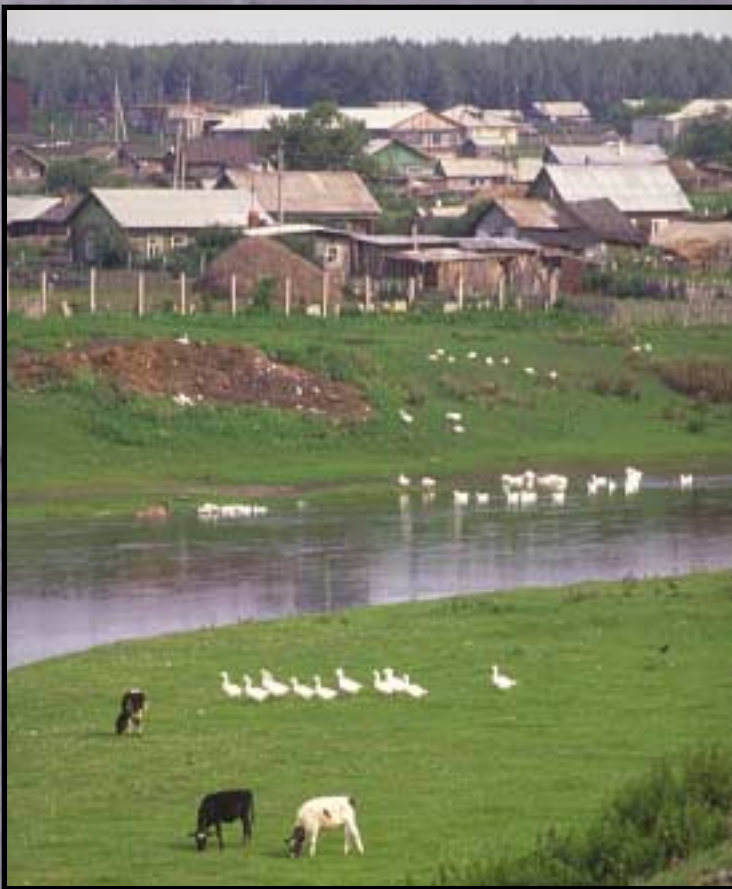
Soviet weapons testing site, and Kyrgyzstan is trying to rid itself of radioactive waste from an old Soviet uranium processing plant. Lithuania is still running two Chernobyl-style nuclear reactors, while Georgian authorities recently revealed that many soldiers there have been contaminated by nuclear waste left by departing Russians at the country’s military bases.

In addition to concerns about radioactive waste, many Western observers are alarmed over the persistent threat of nuclear bomb-making materials being smuggled out of the country. “The problem of ‘loose nukes’ is still going on,” says Matthew Bunn, assistant director of the program in science, technology, and public policy at the Belfer Center for Science and International Affairs at Harvard University in Cambridge, Massachusetts. “In the old Soviet days,” he says, “they didn’t have to worry about anyone stealing bomb-making materials because in a police state, where every meeting with a foreigner was closely watched, who would they be sold to?” Back then, says Bunn, the main threat was keeping Western spies out rather than keeping the materials in. Bunn also says that nuclear workers used to be paid well—now they’re extremely underpaid and worrying about how to provide for their families.

On the other hand, he adds, security at the plants has improved over the past few years as the economy has improved, and Russian president Vladimir Putin has tightened state controls. In addition, hundreds of missiles have been taken apart, tons of enriched uranium have been destroyed, and thousands of scientists who had become frustrated to the point of desperation with decrepit facilities and lack of work have been placed in useful positions, lowering the risk of their involvement in selling secrets. “But,” says Bunn, “we’re still a long way from an ideal level of security.”

Russia at the Nucleus

As the hub of communist rule, Russia acted with general impunity throughout the Soviet Union. Decisions about building nuclear power plants and weapons complexes and disposing of their waste were made and carried out in secret. Some of the most covert activities took place at the Mayak Chemical Combine in the southern Ural Mountains. Mayak was one of the closed “plutonium cities” that were known by the names of nearby towns and a post office box number, such as Tomsk-7 (since renamed Seversk), Krasnoyarsk-26 (now Zheleznogorsk), and in the case of Mayak, Chelyabinsk-40 (now Ozersk). These names have become synonymous



with the worst radioactive contamination in Russia.

“Starting in the late 1940s, the Russians released a great deal of radioactive waste into the waterways near Mayak, including lakes, streams, ponds, and reservoirs,” says Don Bradley, technical group manager of the National Security Division of Pacific Northwest National Laboratory (PNNL) in Richland, Washington, and author of *Behind the Nuclear Curtain: Radioactive Waste Management in the Former Soviet Union*. “At Tomsk-7 and Krasnoyarsk-26, significant quantities of radioactive waste were also injected into the ground. For many years, radioactive effluent at Mayak was released directly into the Techa River, a major source of water for 24 villages along its banks.” All of those villages but one were eventually evacuated.

Much of the air, water, and soil around the Mayak complex contains radioactive isotopes from the plutonium reprocessing that still goes on there. In nuclear reactors, plutonium is produced from uranium via neutron-capture reactions and is used to make nuclear weapons. Plutonium can collect in bones and interfere with the production of white blood cells to cause fatal disease. In addition to building nuclear bombs, Mayak also reprocesses spent nuclear fuel, a practice banned in the United States during the Carter administration primarily because of

concerns over the use of reprocessed fuel to make additional bombs (“proliferation”) and the creation of additional radioactive waste streams. Since the collapse of the Soviet Union, many Russian and Western scientists have worked together to document the extent of the contamination at Mayak.

“Contamination there is perhaps the highest in the world, and the most acute problem in that region is at Lake Karachay,” says Thomas Nilsen, a researcher at the Bellona Foundation, an environmental organization headquartered in Oslo, Norway, that is concerned largely with energy production and nuclear power. “The Soviets started dumping waste from reprocessed plutonium into Karachay in the early 1950s, and extreme levels of radiation are still being monitored there.”

At one time, the most contaminated side of the small bog-like lake—just a few hundred meters across—was so “hot” that a 30-minute exposure would be fatal for 50% of humans, according to Bradley, who visited the lake’s “cool” side with a group of researchers in the 1990s. “We drove out onto the lake with a guy holding a Geiger counter and a watch,” he says. “After 90 seconds, we came back. In that brief time, we received the equivalent dose of radiation of an airplane flight from Moscow to New York.” The lake

contains at least 120 million curies of radioactive waste.

Strontium-90 is readily taken up in the tissues of plants and animals and can enter the human food supply, mainly via milk. It is particularly dangerous for growing children as it is easily deposited in the bones and is believed to induce bone cancer and leukemia. Cesium-137 also accumulates in tissues as it moves up the food chain, and human exposure may result in detrimental health effects or genetic mutations that can lead to cancers, according to the U.S. Department of Agriculture.

Depending on the level of snowfall each winter, Lake Karachay could potentially dry up in the spring and summer, and radioactive waste could be carried on the wind throughout the Chelyabinsk province, or *oblast*. Because of its proximity to Mayak, the area near the lake is uninhabited. But in 1967 the lake did dry up, and radioactive dust was blown over an area of 1,800 square kilometers, contaminating at least half a million people, according to Nilsen. Little is known, however, about subsequent health effects.

To help prevent such lethal airborne contamination, Russian engineers have been gradually covering Lake Karachay with stones and concrete blocks, a controversial remediation method. “The stones help prevent the dust, but the weight also

presses the sediments down and moves them closer to the groundwater,” says Nilsen. “It’s a catch-22.”

Lake Karachay is typical of the challenges the Russians have faced in their attempts to solve their nuclear waste problems. At Tomsk-7, they began injecting liquid radioactive waste into the ground in 1967. To date, tens of millions of cubic meters of waste have been injected into deep holes, according to Michael Foley, a staff scientist at PNNL. Foley says that Russian scientists carefully chose an injection zone to be sure the waste would be isolated from aquifers by subterranean layers of rock. One billion curies of strontium-90 and cesium-137 have been injected so far, which, because of their half-life, would be expected to shrink to one curie in about 900 years. However, according to Nilsen, there are many isotopes present including some long-lived transuraniums, which means, he says, that “after 900 years there will be much more than one curie left.”

Foley and other PNNL scientists have teamed up with Russian scientists in a joint U.S. Department of Energy–Russian Ministry for Atomic Energy (Minatom) program to evaluate the environmental

safety of the injection program. “The people we work with [in Russia] are environmental patriots,” says Foley. “The mistakes that were made during the Cold War are breaking their hearts. At the same time, though, they’re more pragmatic than in the West—antinuclear hysteria hasn’t taken the same hold. They have an awful lot of cleanup to do, and as far as we can see they are dealing with it as well as they can. What they can afford to do, they are certainly doing.”

An Ocean of Waste

The Kola Peninsula, between the Barents and White Seas in northwest Russia, is another major site of actual and potential nuclear contamination. Hundreds of nuclear submarines, Russia’s Northern Fleet, are kept at naval bases along the coast of the peninsula. More than 32,000 spent naval fuel elements are stored on the peninsula in dilapidated buildings and storage facilities or aboard storage vessels, according to Nilsen. Another 32,000 fuel elements have yet to be removed from inactive submarines.

The explosion and sinking of the *Kursk* near the peninsula in August 2000 raised concerns about future radioactive

contamination from that and other submarines’ nuclear reactors. “So far there haven’t been any leaks, and we don’t expect there will be any large ones,” Nilsen says of the damaged *Kursk*. “But corrosion of the hull could someday bring the cold salt water and warm uranium elements into contact with each other and cause considerable contamination. That’s why it’s so important to lift the submarine out of the water and take it on shore as soon as possible. The risk is there, and that’s not a good feeling to have, especially since the *Kursk* is also in the most important fishing grounds of the Barents Sea.”

Far to the east, the Soviets and then the Russians dumped radioactive waste from the Russian Pacific Fleet into the Sea of Japan until 1995, despite protests from the Japanese government. The dumping was halted when the Japanese government agreed to sponsor a waste reprocessing facility that is still under construction. (Russia also reserves the right to resume dumping in the future.)

The Pacific Fleet is generally considered an environmental disaster, although the Russian Navy has been decommissioning many of its submarines, and the volume of waste is gradually being reduced.



A nightmare in storage. Russia is struggling to find a home for decades’ worth of nuclear waste. Liquid radioactive waste was injected into the ground at Tomsk-7 (left), where, despite warnings, local residents still plant gardens in contaminated areas (below). More than 32,000 spent fuel elements from naval vessels such as nuclear-powered submarines (near right) are stored in dilapidated facilities (far right, bottom) and aboard the *Lepse* (far right, top), which sits moored with its toxic cargo in the harbor at Murmansk.



However, the legacy remains. In 1985, a reactor exploded in a nuclear submarine at Vladivostok, and some of the radioactive contamination still remains at the bottom of the bay. Two submarine landing platforms nearby are full of liquid radioactive waste—no one has been able to find a suitable way to dispose of it. As with the *Kursk*, rust is eating away at unused submarines still in the water, and environmentalist observers fear that radioactive particles will eventually leak out.

In the late 1940s, the Soviets built a major nuclear weapons test site near Semipalatinsk, today a city of more than 300,000 in remote northeast Kazakhstan. Until they were banned worldwide in 1962, atmospheric weapons tests were often conducted at the site without warning, sending radioactive particles across the region. Until 1989, hundreds of nuclear bombs were tested in underground caverns. Today, the region is ranked among the most contaminated of the former Soviet Union—many of its residents have reportedly developed leukemia and other blood disorders, babies have been born with neurological and physical defects, and some people have died of what appeared to be radiation sickness. Precise data are

scarce, however; during the Soviet era, medical workers were forced to conceal illnesses that might have been caused by exposure to radiation by either looking the other way or recording a false diagnosis. In 1991, after declaring its independence, Kazakhstan closed the Semipalatinsk facility. In 1999 the last of 181 test tunnels were sealed.

The Fergana Valley of Kyrgyzstan is often called the “breadbasket of Central Asia” because of the lush fields, pastures, and orchards that feed millions of people in the region. But residents there live with the fear that their fertile valley could one day be contaminated by an estimated 2.5 million cubic yards (about 2 million cubic meters) of radioactive waste from a nearby Soviet-era uranium processing plant, according to a 21 October 2000 article in *The New York Times*. The material, much of it radioactive, is buried under thin layers of unstable gravel, sand, and clay—ground that is at risk for earthquakes, landslides, and floods. In the event of such a disaster, rivers, streams, and irrigation canals could transport the material throughout a 60,000 square mile region. Such fears are not without precedent: in 1958, a reservoir wall collapsed, and tons of radioactive material washed

down into the valley, while in 1992, a landslide blocked the river, causing the water to back up and almost reach the waste sites before it began flowing again.

Focus on Cleanup

The most controversial cleanup proposal at the moment—from Minatom—won preliminary approval in January from the Duma (Russian parliament) to allow the importation and disposal of spent nuclear fuel from abroad in exchange for payment. Minatom is planning to turn the contaminated Mayak complex into an international nuclear waste dump. Importing spent nuclear fuel is illegal under current Russian law, but Minatom has successfully argued that the generated revenue—the agency predicts up to US\$20 billion over the life of the project—would go to help clean up contaminated sites. The Duma is expected to change the law in the near future to allow the proposed cleanup strategy.

People from the Bellona Foundation are skeptical that much of the projected revenue would be used to restore contaminated sites. “Although Minatom claims the revenue could reach \$20 billion,” says Nilsen, “at the same time they say that \$13 billion would go to infrastructure to

Left: Thomas Nilsen; right: top, Thomas Nilsen; right: bottom, Bellona Foundation





Refueling Russia. Nuclear fuel reprocessing is a commercial activity in Russia. Spent fuel containing plutonium is shipped from storage vessels (left) by train (above) to the Mayak reprocessing plant. Today, Russian and Western scientists are collaborating on studies to document the extent of the contamination in the Mayak area, which is perhaps the highest in the world.

store and transport the waste. So in the best case only \$7 billion would go to environmental cleanup.”

Spent nuclear fuel includes the fuel rods that are left over when uranium is converted to plutonium. “The rods are highly radioactive; if you stand next to one unshielded, you’ll die in a few minutes,” says Michael Mariotte, executive director of the Nuclear Information and Resource Service, based in Washington, D.C. He says that after rods come out of a reactor, they must be cooled in a pool of borated water for at least several years. Borated water contains boron, which helps moderate the radioactivity in the fuel rods. The rods also have to be kept apart; if they touch each other, the fission process could start up again. “Unfortunately,” says Mariotte, “Russia doesn’t have a very good track record in handling its own waste, much less handling the waste of other countries.”

“The money will be wasted,” says Aleksandr Nikitin, director of the Bellona Foundation’s office in St. Petersburg, Russia. “It will stay within the [beltway] around Moscow rather than be used as it was intended. Russia lacks the technology to manage nuclear wastes and spent nuclear fuel. There are no technologies that can manage this disposal in an environmentally

friendly manner.” He adds, “Mildly speaking, the decision to import spent nuclear fuel like this was a very unpopular decision. The Duma do not understand the dangers of this approach.”

On the other hand, Bunn says, if appropriate arrangements are made for the shipping and disposal of the fuel and the use of revenue, then the danger to Russians from the imported fuel would be very small compared to that from the contamination that would be fixed with the money generated. According to Bunn, one of the “dirty little secrets” about nuclear fuel is that most of it originates in the United States and is sold to other countries, an arrangement that through trade agreements gives the U.S. government veto power over where the fuel is sent and leverage to insist that the money be used for nonproliferation and cleanup and not wasted.

Mariotte adds that more than 150 environmental groups sent letters to the U.S. State and Energy Departments last December urging the government to block the entire Russian program by refusing to allow waste of U.S. origin to be imported into Russia. “Many of us are deeply skeptical that U.S. insistence that the money be spent on cleanup would actually mean the money would be spent on cleanup,” says Mariotte. “Minatom wants the program

because it wants funding to build new reactors, not to clean up its existing messes.”

Western attempts to help remedy some of the radioactive contamination problems in the former Soviet Union have met with a mixture of approval and concern. For example, the European Commission recently approved a \$585 million loan to help Ukraine build two new reactors that would make up for the loss of nuclear-generated electric power from Chernobyl. The European Bank for Reconstruction and Development has offered to contribute another \$215 million. However, experts disagree over whether the new reactors will be much safer than the old ones.

“Ukraine had started building these reactors under the Soviet Union,” Mariotte says, “and over the years they’ve been slowly working on them as construction projects. In return for closing Chernobyl, Ukraine insisted that the West compensate them for the lost power by helping to complete these reactors.” Mariotte says the European Bank loan is the most controversial that the group has ever approved; 32% of its member banks rejected the proposal or abstained from the vote. “They’re concerned because the reactors are of old Soviet design and still won’t meet Western safety standards when they’re completed,” he explains.



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The Whistle-Blowers

Aleksandr Nikitin was an average Russian naval officer until his retirement in 1992. Four years later, however, he coauthored a report, published by the Oslo-based environmental group the Bellona Foundation, claiming that Russia's nuclear submarines were in a dangerous state of disrepair, a revelation that landed him first in jail, then under house arrest. The charge of espionage—having disclosed defense secrets to a foreign power—made him the first political prisoner since the official collapse of the Soviet Union at the end of 1991. Nikitin claims, however, that the information he gave to the Bellona Foundation was already in the public domain; all he did was help compile it.

"To solve the problem, you have to talk about the problem," says Nikitin. "One of the most important points was to start discussing the situation. If we hadn't started revealing such information, it's quite possible that no one would have heard anything about the *Kursk* when that happened. Back [during the time of] the Soviet Union, when submarines sank no one heard anything about it."

After numerous trial appearances, Nikitin was acquitted of the charges in December 1999 by the City Court of St.



Nikitin at the Supreme Court



Pasko in detention

Petersburg. Russian prosecutors appealed the acquittal, but the Russian Supreme Court Presidium upheld it, making Nikitin the first person in history to be acquitted on espionage charges in Russia, according to Thomas Nilsen, a researcher at the Bellona Foundation. Nikitin is now head of Bellona's office in St. Petersburg.

In July 1999, after 20 months in prison, Grigory Pasko was cleared of high treason charges for revealing the Russian Navy's practice of dumping liquid radioactive nuclear waste into the Sea of Japan. Pasko, who in addition to being a naval captain was an investigative journalist for *Battle Watch*, the official Pacific Fleet newspaper, filmed the dumping in 1993 and gave the tape to the Japanese television station NHK. Pasko was sentenced by a military court in Vladivostok to three years in prison on a lesser charge—abuse of his official position—but was freed presumably in response to public pressure by international journalist organizations and Amnesty International, which declared him a prisoner of conscience. He is now attempting to clear his name, according to a series of articles from July 1999 to the present in the *Vladivostok News*. The Federal Security Service, successor to the KGB, is now having him retried for treason. That trial began on 22 March 2001. —Rebecca Clay

Some attempts in another area—to help upgrade Russian nuclear technology—have also met with resistance. The German Green Party protested when a German company announced plans to sell plutonium-processing equipment to Russia, arguing that the country should not trade in nuclear technology with the former Soviet Union. Although the German government supported the sale, contending that there is a global interest in making weapons-grade plutonium less dangerous through better processing, the project has been put on hold.

In 1998, the United States began providing Russia with \$30 million in assistance to help bring commercial ventures to Russia's closed "nuclear cities." The Nuclear Cities Initiative was launched in 1998 to accelerate the consolidation of Russia's nuclear weapons complexes and to create civilian jobs for displaced nuclear weapons workers. To date, 30 civilian projects have been funded through the initiative that will potentially employ more than 700 people. The impetus for the initiative was the desire to attract Western investment to the area; the hope is that such improvements will keep Russia's best scientists from leaving to work for aspiring nuclear powers such as Iran and Iraq, and may also help discourage the theft of

nuclear weapons from the cities' facilities. Experts disagree on whether the Nuclear Cities Initiative has led to positive change, and according to Mariotte, the Bush administration is planning to cut its funding as part of a general "lessening of cooperation" with Russia.

According to Bunn, the United States has given Russia almost no money for cleanup because of both an attitude that the contamination is the Russians' problem and a lack of adequate funds to tackle such hugely contaminated areas as Mayak. "The Japanese and Norwegians have been putting in more money, but it's still small potatoes compared to what is needed," he says. "Most of the U.S. money spent has been for things felt to benefit our own security, such as security systems and providing jobs to scientists. . . . But we can kill two birds with one stone by spending a small amount of the cleanup research and development money we're spending anyway on Russian scientists, who would work for less and would develop solutions that both Russia and the United States could use."

In the meantime, Russian environmental groups such as Ecodefense and the St. Petersburg branch of the Bellona Foundation have been vigorously opposing what they see as the Russian government's flagrant disregard for the environmental

health effects of mounting radioactive contamination throughout the country. For example, Ecodefense has organized numerous protests in the Mayak area to let people know "what they are living next to," according to Sliviyak.

"The present [political] climate in Russia is not very warm toward this kind of activity," Sliviyak says. "We want to establish a strong, open, and democratic society that would allow the public to have control over its authorities and to keep track of what they're doing to solve these problems. It's important for all of us to be working for the betterment of people who are suffering from environmental disasters in Russia."

Radioactive contamination disasters in the former Soviet Union know no boundaries, as evidenced by the accident at Chernobyl. Nuclear power plants, weapons plants, and submarines in disrepair, coupled with disregard for the environmental health consequences of poorly implemented disposal programs, pose a global threat. It remains to be seen how the global community will respond to these issues, but experts agree that the nuclear threat remains a serious problem that will not go away on its own.

Rebecca Clay